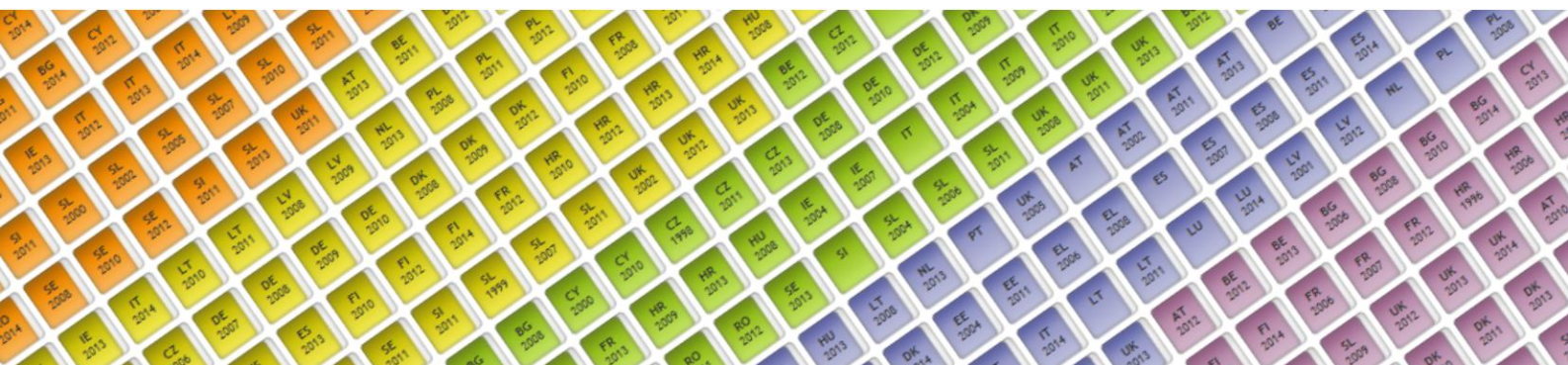




## 2015



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**Abstract**

The report offers an analysis of the R&I system in Italy for 2014, including relevant policies and funding, with particular focus on topics critical for two EU policies: the European Research Area and the Innovation Union. The report was prepared according to a set of guidelines for collecting and analysing a range of materials, including policy documents, statistics, evaluation reports, websites etc. The report identifies the structural challenges of the Italian research and innovation system and assesses the match between the national priorities and those challenges, highlighting the latest policy developments, their dynamics and impact in the overall national context.

## **Acknowledgments**

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## Executive summary

Italy's research and innovation (R&I) system has experienced little improvement in 2014. The economic crisis has continued, with a further fall of GDP in 2014 (-0.3%), after the decreasing by 1.9% in 2013 and 2.3% in 2012. The economic depression and austerity policies cutting public expenditure have been a major constraint on public and private R&D and innovation efforts. In 2012 total expenditure on R&D (GERD) was €20.5bn, with a 1.9% increase in real terms over 2011. Preliminary data for 2013 report a 2.9% fall in real terms over 2012; a further 1.9% fall in public R&D appropriations and a 1.4% increase in firms' expenditure is expected by the Italian National Statistics Institute (ISTAT) for 2014. The gap with the EU averages is growing; as a share of GDP, in 2013 Italy's R&D amounts to 1.25%, against a 2.02% level for the EU as a whole. Italy's R&D per capita is €339, against €539 for the EU-28 average. Italy's Europe2020 target is a R&D/GDP ratio of 1.53%; in order to reach this target Italy's R&D should increase – assuming a constant GDP – by €4bn, an amount far from the resources made available by the current policies.

Innovation in firms – documented by the CIS 2012 survey, covering the period 2010-2012 – is limited, with one third of enterprises that have actually introduced at least a product or process innovation; their economic impact accounted for 16% only of 2012 turnover. Total expenditure for innovation was €24bn in 2012, 50% of which went to R&D. This amounts to €6,300 per employee, a value that is substantially lower than the €7,700 per employee spent for innovation in 2010.

Conversely, good news came from the analysis of the publication performance of Italy's researchers documented by the ANVUR, the body in charge of the monitoring and evaluation of the research system, report on the university and research system (ANVUR 2014). Data show that Italy's share of world scientific publication – based on the ISI Web of Science and SCiVal Scopus databases – is 4.4% in the fields of 'hard sciences' and 1.9% in social sciences and humanities, with an increasing trend in both areas. Within "hard sciences", Italy is specialised in Mathematics and physics, Earth sciences, Health sciences, and in Decision sciences, Economics and finance and Psychology for social sciences and humanities. Citations of Italian articles are below those of the UK, but similar to those of Germany and higher than French ones. When we relate scientific output to R&D expenditure, Italy shows 3.88 publications per million R&D, as opposed to 2.33 in France, 1.78 in Germany, 4.14 in the UK. When only public R&D is considered, the values are 9.15 for Italy, 6.55 for France, 5.42 for Germany and 11.31 for the UK. The latter indicator has increased substantially over the previous five years for Italy, while it has declined for Germany and remained stable for the other countries. When productivity is measured in relation to the number of researchers, we find that Italy produced 0.54 articles per total researcher as opposed to 0.31 in France, 0.27 in Germany and 0.38 in the UK. It is remarkable that, in a context of falling public resources, the productivity of Italian researchers has continued to improve.

R&I policy has shown a broad continuity, but also some effects of the two government changes in May 2013 (Letta government) and in February 2014 (Renzi government). The new 'Programma Nazionale per la Ricerca 2014-2020' has been drafted in February 2014 but, with the new government, it has not yet obtained the required approval from Inter-ministerial Committee for Economic Programming (CIPE). Despite a growing share of R&I distributed – either to universities, PROs or private firms – on the basis of performances or

specific projects, the general reduction of resources is offsetting the expected benefits from improved allocation efficiency. Public support to firms' R&D has been provided on the one hand through tax credits, with measures that have been characterised however by frequent changes. On the other hand, government provided direct incentives to firms through a variety of funds – including “Fondo delle agevolazioni alla ricerca” for industrial R&D, MISE's “Fondo per la Crescita Sostenibile” fund and PONREC plan for cohesion projects – that however had limited resources. No funds were available for the research programmes of PRIN or FIRB – mainly oriented towards universities and PROs – and no calls have been launched in 2014.

In 2014, the results of the first ‘Abilitazione Scientifica Nazionale’ (ASN) – a national ‘Qualification’ system for scholars who want to become candidates to positions of Full and Associate professor – were published, and the second round was carried out, with full results available in 2015. The first year of the ASN had 59,150 applications – 18,061 for full professor and 41,089 for associate professor – and a success rate of 43% for both. An official comprehensive assessment by MIUR of the results of the ASN exercise is not yet available. With the new government, limited changes have been introduced in the ‘Qualification’ system and the new round of evaluations has been postponed. With a large number of scholars in possession of the ‘Qualification’ and eligible to be hired, little resources have been made available to universities for hiring new staff. An uneven rate of authorised turnover – ranging from over 100% to 20% of retiring staff – has been introduced by MIUR for universities at the end of 2014; considering the large numbers of retiring professors, this leaves most Italian universities – especially smaller ones, in Central and Southern Italy – critically understaffed.

Several other R&I measures and regulations have been introduced by MIUR and ANVUR; Italy's R&I actions have continued to move broadly in line with EU priorities in a variety of fields, and Italy's participation in FP7 projects has shown positive results.

The evidence provided by this report identifies five main structural challenges for Italy's R&I system. First, the downsizing of higher education has continued, with a reduction in funding, staff and students. The expected fall in staff numbers due to retirement and the lack of new openings for young researchers are serious developments, which could make universities unable to perform their institutional role in higher education and research. It is a paradox that such a downsizing takes place when the above evidence on the productivity of research puts Italy at the top of international rankings.

Second, the weak formation of human capital and the brain drain of researchers are critical issues. Whether we consider educational levels among the population, university students and graduates, the relevance of high skills, or the number of researchers working in the country, we always find a weakening of Italy's position and a growing gap with European standards. While comprehensive data on the ‘brain drain’ of researchers is not yet available, fragmentary evidence suggests that several thousand Italian researchers are now working abroad – a serious loss for Italy's R&I system.

Third, the weak R&D and innovation activities of firms – already pointed out above – have been made worse by the economic depression that has led to a fall of more than 20% in industry output compared to pre-crisis 2008 levels. Italy risks losing important R&D and technological capabilities in firms, after having lost in past years a large part of its high technology industries.

Fourth, Italy's size distribution of firms remains dominated by the 4.1 million firms with 1 to 9 employees, while only 3,500 firms have more than 250 employees. The ownership and organisational models, the financial constraints and the limited knowledge base that are typical of SMEs are all factors that prevent a move towards greater R&D and innovation activities.

Fifth, the territorial inequalities between Northern and Southern regions – and, more generally, with 'peripheral' areas – show signs of worsening in terms of R&I activities, higher education and in broader socio-economic terms. Cohesion efforts have focused on the four regions of the South – Sicily, Calabria, Puglia and Campania – eligible for EU Convergence Objective 1 policies, with some positive initiatives that, however, have been inadequate to reverse divergence.

If such trends continue, parts of Italy's R&I system may become unable to operate effectively, a permanent loss of R&I competences and human capital may take place, and the distance from Europe would increase, putting at risk the possibility to integrate Italy's activities in the European context. Five cross-cutting policy changes may be needed to meet such structural challenges. First, the resource gap has to be urgently addressed, with an immediate return to 2008 levels of public and private R&I funding and personnel, in order to avoid a widening of Italy's lag behind EU standards. Second, a new public-private balance is required; for decades, public activities have been downsized in the hope that private initiatives could take the lead in R&D, innovation and investment; this has simply not happened and there is the need to rebuild a capable and competent public sector, less concerned with short term private-style 'efficiency', and more concerned with the long term priorities of the country's R&I system. Third, there is a need for a new role of larger firms, SMEs networks and the banking system for reconstructing the conditions for innovation in the economy, especially in emerging fields, in the context of a new industrial policy. Fourth, restoring convergence across Italy's regions – and across Europe's countries – is an essential requirement for preventing economic, social and political disintegration and a 'vicious circles' of decline, unemployment and 'brain drain'. Fifth, Italy's problems provide evidence of some limitations that can be found in the EU R&I priorities, that were defined in a context very different from the present economic crisis. Reconsidering some of Europe 2020 targets, the emphasis on competitive funding for R&I excellence, the approach to convergence policy and – more broadly – EU constraints on budgetary and industrial policy appear to be important steps that could help improve Italy's future in research and innovation.

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# 1. Overview of the R&I system

## 1.1 Italy in the European RDI landscape

Italy is a large EU country (60.8m of inhabitants in 2014<sup>1</sup>) accounting for nearly 12% of the EU28 population. The economic performance of the country has been negative from the start of the crisis and GDP did not yet return to its 2008 values. In 2012 and 2013 GDP growth in real terms has been negative, (respectively -2.3% and -1.9%) and the National Institute of Statistics (ISTAT) expects a negative outlook for 2014 too (-0.3%)<sup>2</sup>. This economic depression has changed the position of the country within the EU; in 2013 GDP per capita – traditionally much higher than the EU28 average – was €26,700, only €100 higher than the EU28 average. The fall in GDP has led to a worsening of the ratio of sovereign debt to GDP, which rose from 102.3% in 2008 to 127.9% in 2013. Since 2010, the economic policy of the country has been characterized by austerity measures, public budget cuts and fall of investment, affecting the dynamics of R&D expenditure and innovative activities.

Considering Research and Development (R&D) efforts, in 2012 GERD recorded an increase over 2011 of 1.9% in real terms<sup>3</sup>, but provisional data for 2013 show a fall of 2.9% (about €300m) over 2012. The R&D intensity national target – R&D expenditure equal to 1.53% of GDP – is still far away and the gap with the EU-28 average is persisting. In 2011 the R&D to GDP ratio was 1.21% as opposed to a EU-28 average of 1.97%. In 2013 the R&D to GDP ratio was 1.25%, as opposed to a EU-28 average of 2.02. In 2013 Italy's total R&D personnel (in full time equivalent units) amounted to 252,648, of which 117,973 researchers. In 2013 Italy's share of R&D personnel on total employment was 1.13%, as opposed to a EU28 average of 1.25%; the share of researchers was 0.53% as opposed to 0.79% in the EU28 average. Expenditure for universities accounts for 1% of Italy's GDP, as opposed to 1.5% in the EU average.<sup>4</sup>

Evidence on innovation in firms has been provided by the results of the latest Innovation Survey; according to the CIS 2012 survey<sup>5</sup>, in the period 2010-2012, 51.9% of the firms with more than 9 employees introduced at least one innovation, with a slight increase from the previous years; total expenditure for innovation amounted to about €24bn in 2012, 50% of which went to R&D expenditure. The economic impact of the innovations introduced was rather limited, accounting for 16.3% of total turnover in 2012. Innovations have been introduced with limited cooperation with other organisations – 12.5% of innovating firms; cooperation with the public sector and with HEIs is low and cooperation with foreign firms is marginal.

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<sup>1</sup> Eurostat (2014) Eurostat New Cronos database, December 2014; in chapter 1 the source for data is New Cronos if not evidenced by a different footnote.

<sup>2</sup> ISTAT, Le prospettive per l'economia italiana, Roma, 03/11/2014

<sup>3</sup> In 2012 total R&D expenditure reached €20.5b from €19.8b in 2011 (ISTAT, 2014a)

<sup>4</sup> CUN (2013).

<sup>5</sup> ISTAT (2014b).

## ***1.2 Main features of the R&I system***

Italy's R&D system is based on a mixed private-public funding model; in 2012 47.1% of resources for R&D have been provided by the business sector and 43.5% by the public sector. Funds from abroad – including EU funds – accounted for 9.5% of R&D financing (ISTAT, 2014a, p.2).

The governance structure of Italy's R&I system is based on the top role played by the Council of Ministries, which defines priorities and outlines policies in the National Research Programme (PNR)<sup>6</sup>, the main government document for R&D planning.<sup>7</sup> The Horizon Italia 2020 (HIT2020)<sup>8</sup> document reports government R&D planning within the European framework.

## ***1.3 Structure of the national research and innovation system and its governance***

The Ministry for education, research and universities (MIUR) is the main player in R&I, in charge of coordinating national and international scientific activities, supervising the academic system, funding universities and research agencies, and supporting public and private research and technological development. MIUR coordinates the preparation of the PNR in consultation with other Ministries, Regions and other stakeholders.

The National Agency for the Evaluation of Universities and Research Institutes (ANVUR) is in charge of the monitoring and evaluation of the research system. ANVUR started its activities in 2011<sup>9</sup> and has expanded its role overseeing universities, setting the ground rules for the authorisation of university courses and for the national 'Qualification', the system introduced in 2012 for recruiting professors in universities. In 2013 ANVUR published the first evaluation report on Italy's universities and PROs (ANVUR, 2013). In 2014 the report on the state of research in Italy was published<sup>10</sup>.

The Inter Ministry Committee for Economic Planning (CIPE) has the role of coordinating science and technology policy – focusing on medium and long-term actions – and releases the PNR proposed by MIUR. CIPE also reviews the Economic and Financial Document (DEF) which includes the National Reform Programme, relevant for monitoring the policy agenda and its impact on the R&I system.

The Ministry for economic development (MISE, previously Ministry for Production Activities) manages industrial innovation. The Department for Competitiveness within MISE is in charge of technological innovation and responsible for industrial policy, industrial districts, energy policies, policies for SMEs, and instruments to support the production system. The Department of development and social cohesion (DPS) within MISE is in charge of the planning, coordination and management of EU Structural funds and in the multiannual programme Quadro Strategico Nazionale 2007-2013 (QSN) has outlined specific actions for research and innovation<sup>11</sup>. The DPS and MIUR jointly coordinate Italian participation to Horizon2020 according to the HIT2020 strategy, and coordinate the Smart specialisation

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<sup>6</sup> MIUR (2014a) [www.istruzione.it/allegati/2014/PNR\\_online\\_21feb14.pdf](http://www.istruzione.it/allegati/2014/PNR_online_21feb14.pdf)

<sup>7</sup> Legislative Decree no. 204/1998

<sup>8</sup> MIUR (2013) <https://www.researchitaly.it/uploads/50/HIT2020.pdf>

<sup>9</sup> Formally created by Law 186/2006.

<sup>10</sup> (ANVUR, 2014)

[http://www.anvur.org/attachments/article/644/Rapporto%20ANVUR%202013\\_UNIVERSITA%20e%20RICERCA\\_integrale.pdf](http://www.anvur.org/attachments/article/644/Rapporto%20ANVUR%202013_UNIVERSITA%20e%20RICERCA_integrale.pdf)

<sup>11</sup> A new QSN for the 2014-2020 reprogramming is not available yet.

strategy. Other Ministries (Health, Agriculture, Defence, etc.) manage research funds in their specific fields. The Digital Italy Agency (AgID), established in 2012<sup>12</sup> is in charge of the Italian Digital Agenda (IDA) under the control of the Prime Minister's office.

Responsibility for R&I policies has remained in the hands of the national government. Regions, under the concurrency principle, develop local initiatives in R&I and contribute to policy making on R&D; in some cases, research organisations are funded and managed by Regions. In particular, Regions manage the innovation funds within the PONREC framework, concerning the R&I activities that are part of territorial cohesion policies. The Agency for territorial cohesion has been created in order to coordinate the use of EU Structural funds and cohesion efforts, including R&I regional actions; however, at the end of 2014 the Agency is not yet operational.

The university system is not playing a major role in the decision making process on R&I policy. The National University Council (CUN) is an elected body representing the Italian university system and acts as the independent consultative body of MIUR on university policy, national research programmes, funding allocation and recruitment policies. CRUI, the conference of university Rectors, is also playing a role in consultation over higher education policies.

Public research is based on universities and Public research organisations (PRO). In 2014, 95 universities were active, of which 67 are public institutions and 11 provide on-line education only ('Università Telematiche')<sup>13</sup>. The National Research Council (CNR) is the largest public research organisation under the supervision of MIUR. The National Agency for New Technologies, Energy and Sustainable Development (ENEA) has the mission to carry out R&D on energy and environment.

Funding decisions for R&I are included in the government budget and in the "stability law" approved by Parliament at the end of every year, where funds for research and innovation are budgeted, including a three year planning. Ordinary funds for universities and public research organisations are provided by two budget lines (FFO and FOE). FIRB and PRIN are the competitive funding programmes for research activities by HEI and PROs. Business R&D is financed through the Research support fund (FAR) managed by MIUR, while innovation is financed by the FIRST fund managed by MISE. Regulations for allocating these resources have been revised in 2012, 2013 and 2014 in order to streamline access. Tax credits and low interest loans are tools for supporting private R&D. The National operational programme for research and competitiveness 2007-2013 (PON) managed by MISE and MIUR provides additional funding to public and private research.

Considering private sector R&D, Fiat (automotive), Finmeccanica (aerospace and military), Telecom Italia (telecommunications), Unicredit and Intesa San Paolo (banking) are the most relevant R&D players, included in the top 100 EU companies ranked by R&D<sup>14</sup>. Since 2010 Fiat – the main private player in R&D – downsized its economic activities in Italy and in 2014 became Fiat Chrysler Automobiles (FCA), moving its headquarters abroad.

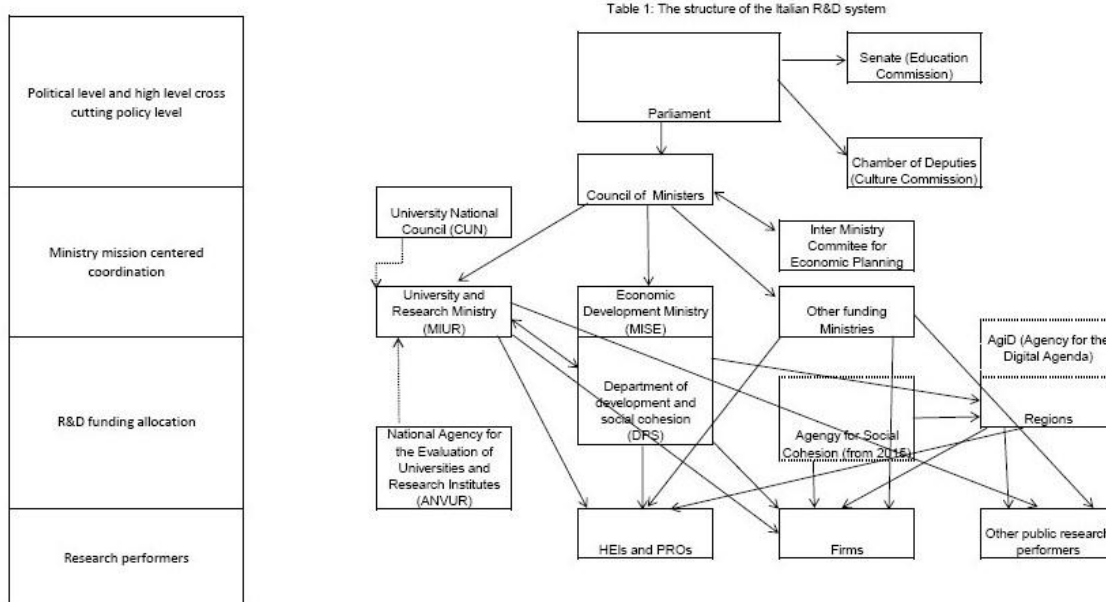
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<sup>12</sup> Law 134/2012 which amended the constitution of the previous agency for the Agenda Digitale that has never been fully operational.

<sup>13</sup> The full list can be downloaded from the MIUR portal <http://cercauniversita.cineca.it>;

<sup>14</sup> 2014 EU Industrial R&D Scoreboard <http://iri.jrc.ec.europa.eu/scoreboard14.html>

**Figure 1. Italy's RDI governance system**



### **Main changes in 2009**

Reform law of PROs

### **Main Changes in 2010**

Reform law of HEIs

### **Main changes in 2011**

ANVUR activities for the first R&I assessment

Creation of AgiD (Agency for the Agenda Digitale)

### **Main changes in 2012**

National Qualification system (new recruitment system of professors)

New doctoral reform (not implemented yet)

New regulations for the major Research funds

Start-up law

### **Main Changes in 2013**

Publication of the ANVUR assessment report

Institution of the Agency for territorial cohesion (not yet operational)

Creation of AgiD (Agency for the Agenda Digitale)

### **Main Changes in 2014**

New PNR (not implemented yet)

Changes in the Qualification system

New tax credits scheme

## **2. Recent Developments in Research and Innovation Policy and systems**

### ***2.1 National economic and political context***

From late 2012 to 2014 Italian politics was marked by a succession of three governments – all supported by varieties of ‘grand coalitions’ between centre-left, centre and centre-right parties. Economic policies, however, showed a fundamental continuity, focusing on budget austerity and economic ‘reforms’; action in the field of Research and Innovation (R&I) was also characterised by a continuation of previous policies.

The government of Mario Monti resigned at the end of 2012, after the approval of the budget law. Elections were held in February 2013, leading to a deadlock as no coalition obtained a clear majority in the Senate. In May 2013, the government of Enrico Letta took office, with Maria Chiara Carrozza – a scientist from Scuola Superiore Sant’Anna in Pisa – as the new Minister of Education, University and Research. Political turmoil in the coalition and in governing parties, however, constrained policy action. In early 2014 the nomination of Matteo Renzi as the new leader of the Democratic Party led to a change in government; in February 2014 the new government led by Matteo Renzi took office, supported by the same ‘grand coalition’ of parties. The new Minister of Education, University and Research, is Stefania Giannini, a professor of the University of Perugia and senator of Scelta Civica, Mario Monti’s former party. In her audition in Parliament<sup>15</sup>, she presented a strategy based on four pillars – simplification, programming, evaluation and internationalisation.

The research and innovation (R&I) system of Italy continues to be affected by the economic depression. Italy’s GDP is expected to fall in real terms by 0.3% in 2014 and grow by 0.5% in 2015.<sup>16</sup> Both data are below EU averages; for more than a decade Italy’s performance has lagged behind EU growth. This has a serious impact on R&I activities, with limited resources for public and private R&D, cutbacks in public budget, weak investment in innovation by firms.

### ***2.2 National R&I strategies and policies***

The change in government has led to a suspension of some of the initiatives undertaken by the previous Minister Maria Chiara Carrozza. In particular, the new ‘Programma Nazionale per la Ricerca 2014-2020’ (PNR, MIUR 2014) that had been presented as draft in February 2014 – and should be the key policy document for R&I – did not proceed beyond draft stage; in order to become operational the approval of the Inter Ministry Committee for Economic Planning (CIPE) – that is in charge of the coordination of science and technology policy – is required. The policy framework for R&I in Italy is also provided by the document “Horizon 2020 Italia Ricerca e Innovazione” (HIT2020, MIUR 2013b). Both documents further develop the strategic framework followed in previous years and give more attention to innovation issues; they also pursue some advancement of Italy’s R&I towards

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<sup>15</sup> Audition of the Minister of education, universities and research Stefania Giannini at the Culture Commission of the Chamber of Deputies 01/04/2014,

[http://www.camera.it/leg17/1058?idLegislatura=17&tipologia=audiz2&sottotipologia=audizione&anno=2014&mese=04&giorno=01&idCommissione=07&numero=0008&file=indice\\_stenografico](http://www.camera.it/leg17/1058?idLegislatura=17&tipologia=audiz2&sottotipologia=audizione&anno=2014&mese=04&giorno=01&idCommissione=07&numero=0008&file=indice_stenografico)

<sup>16</sup> ISTAT, Le prospettive per l’economia italiana, Rome, 3 November 2014, <http://www.istat.it/it/archivio/137380>. After the slump of 2009 (-5.5%), Italy’s GDP stagnated in 2011 (+0.4%), fell in 2012 (-2.3%) and in 2013 (-1.9%).

Europe 2020 commitments. In the section below a summary of their content is provided, although it is not yet clear whether the current government will modify any of the policy priorities they contain.

Similarly, the new Minister Stefania Giannini stopped the procedure for the 'Qualification' of candidates for professor positions in Italian universities. The experience of the first two years with the first set of evaluating committees has been concluded and no new procedure has been set in motion, in spite of previous norms that planned 'Qualification' procedures on an annual basis. A new call that will lead to the formation of new evaluating committees may be announced in early 2015. An analysis of the results of the 'Qualification' procedure is offered in the section on universities below.

## **The National Research Programme 2014-2020**

The new National Research Programme<sup>17</sup> proposes an integrated approach towards education, innovation and research with a special focus on public-private cooperation. The strategy has been set up on a seven-year term in order to be in line with the EU Horizon 2020 programme and with the EU Structural Funds programming period, facilitating joint planning and implementation. It complements the strategic document HIT2020 released by MIUR in 2013. It provides a roadmap for R&I for the years 2014-2020, aiming at an advancement of frontier science and at the implementation of the Europe 2020 strategy. The main goals include simplification, effectiveness and efficiency of investment in R&I; greater researcher mobility and ability to attract larger shares of EU financing. MIUR plans to allocate around €900m each year to implement the measures included in the new PNR. The PNR 2014-2020 defines 11 Grand Challenges for the R&I system:

1. Scientific and cultural progress;
2. Health, demographic change and wellbeing;
3. European bio-economy challenges;
4. Secure, clean and efficient energy;
5. Smart, green and integrated transport;
6. Climate action, resource efficiency and raw materials;
7. Europe in a changing world - inclusive, innovative and reflective societies;
8. Space and astronomy;
9. Secure societies - protecting freedom and security of Europe and its citizens;
10. Restoring, preserving, valuing and managing the European Cultural Heritage, Creativity;
11. Digital Agenda.

It relies on 3 strategic layers:

- Attracting human capital from abroad;
- Defining and funding a limited number of large projects with a high impact on the quality of life;
- Promoting innovation and innovation transfer to businesses with a special focus on SMEs.

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<sup>17</sup> MIUR (2014a) [www.istruzione.it/allegati/2014/PNR\\_online\\_21feb14.pdf](http://www.istruzione.it/allegati/2014/PNR_online_21feb14.pdf)

The new PNR also includes attention to research infrastructures, a traditional strength of the Italian R&I system.

In a context of budget austerity, the main constraint identified by the PNR is the limitation of public resources, as it envisages a constant flow of funds for R&I from the national budget. Such constraint is causing delays in the implementation of new policies and major reductions or cancellation of specific programmes. In particular:

- Indirect R&D incentives to firms in the form of R&D tax credit schemes have been limited by the reduced amount of available resources compared to 2008 and 2009.
- In 2013, FAR, the main fund for industrial research, was stopped for the lack of financial resources<sup>18</sup>.
- PRIN and FIRB, the two competitive research programmes, have not been regularly budgeted over the last five years, with major cuts in their financing.

The result of such developments is that progress towards Europe2020 R&D targets has been very limited. One way to address this problem is a closer integration with other EU policies. The PNR 2014-2020 has the explicit aim to integrate Structural Funds in R&I policies - as stressed also in the HIT2020 strategic document. This document envisages a stakeholder consultation aimed to design a shared strategy taking into consideration the interests of society; an analysis of the strengths and weaknesses of the national R&I system is also proposed, leading to identify the Smart Specialisation Strategy that could become a policy priority.

## **Developments in University funding**

At the end of 2014 the new ordinary funding plan (FFO) for universities was published by the Ministry of Education, Universities and Research (MIUR), and the 'Stability law' on budget allocations for 2015 was approved by Parliament<sup>19</sup>. These measures introduce a €150m increase of FFO over 2013 values that however incorporates 'merit funds' and other resources that were previously in separate budget lines. At the same time the government spending review cuts €34m from university purchases of goods and services. The net effect on the overall funding of universities is therefore unclear, but only modest changes are expected.

The funding plan of MIUR introduces two new mechanisms for the distribution of funds among universities. First, 20% of the FFO is distributed among universities on the basis of a 'standard cost' per student, with a new (but not yet tested) mechanism of resource allocation. Second, 18% of the FFO will go to 'better performing' universities, and is distributed in the following way:

- for 70% on the basis of their performance in the ANVUR quality assessment review (ANVUR, 2013);
- for 20% on the basis of their recruiting policies (scientific production of the professors that are recruited or promoted assessed by ANVUR);

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<sup>18</sup><http://hubmiur.pubblica.istruzione.it/web/ricerca/dettaglio-news/-/dettaglioNews/viewDettaglio/24402/11213>

<sup>19</sup> MIUR, Decreto ministeriale 4 novembre 2014, n.815. Decreto criteri di ripartizione del Fondo di finanziamento ordinario (FFO) delle università per l'anno 2014. L. 23/12/2014 n.190 Disposizioni per la formazione del bilancio annuale e pluriennale dello Stato (Legge di stabilità 2015).



- for 10% on the basis of the relevance of international teaching activities, combining the presence of foreign students and the courses followed abroad by local students.

Additional funds mainly directed to fund research in universities on a competitive basis include PRIN (Progetti di interesse nazionale) and FIRB (Fondo per gli investimenti nella ricerca di base). Resources for PRIN decreased from €100m in 2009 to €38.2m in 2012.<sup>20</sup> Resources for FIRB in the call launched at the end of 2012 were €29.5.<sup>21</sup> In 2013 and 2014 MIUR did not launch any new FIRB or PRIN call. In January 2014, MIUR published the competitive funding call SIR (Scientific Independence of Young Researchers) addressed to young researchers.<sup>22</sup> The budget of €47m is aimed to finance projects managed by young researchers in any scientific domain of the ERC. Competitive funds of these types have so far failed to provide a substantial source of funds for HEI research.

The trend of reduction of university expenditure has been widely criticised. In its 2014 report on the university and research system, ANVUR examined an international comparison of funding trends and concluded that there is “effective evidence of an under-financing of tertiary education in our country” (ANVUR 2014, p.158).

A 2013 study of the Bank of Italy argues that “the cuts to the ordinary funding of universities (about 750 millions in nominal terms between 2008 and 2013) do not appear, for instance, to be coherent with the commitments of Europe 2020 for an expansion of the share of young graduates, nor they seem to be based on a clear strategy in the field of research and innovation”<sup>23</sup>. The authors also lament that a serious public policy debate on these issues has so far failed to emerge in Italy’s political and economic context.

In 2013 the Consiglio Universitario Nazionale (CUN), the representative body of universities within MIUR, released a report on the ‘emergency’ situation of the higher education system showing that ordinary funding for universities has continuously decreased in real terms since 2009 – first with the Berlusconi and then with the Monti governments.<sup>24</sup>

The underfinancing of Italy’s universities has been pointed out also by international organisations such as the OECD that in its report ‘Education at a glance’ (OECD 2013) has shown that in 2011 Italy’s expenditure per university student was one third lower than in the OECD average – 10,000 US dollars against \$14,000; France had an expenditure of over \$15,000 and Germany was close to \$17,000, with the gap increasing over time if we look at previous editions of the OECD report (ibid., p.207). The same gap is found when expenditure for tertiary education is related to GDP; in 2011 the share for Italy was just 1%, against an OECD average of 1.6%, and values of 1.5% in France and 1.3% in Germany (ibid., p.230). Considering expenditure for all levels of education in 2008 equal to 100, in

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<sup>20</sup> PRIN call D.M. 28 December 2012 n. 957/Ric.

<sup>21</sup> FIRB call 2012 D. M. 28 December 2012 n. 956/Ric.

<sup>22</sup> SIR call 2014 D.D. 23 January 2014 n. 197. <http://www.sir.miur.it>

<sup>23</sup> (Montana and Torino 2013, pp.40-41).

<sup>24</sup> (CUN, 2013, p.6) CUN has argued that the fall in financing has led to fewer professors, fewer students, and fewer courses. The number of new students enrolments in 2011-2012 decreased dramatically from 2003-2004 (-17.2%) and in 2012 the university system reported nearly 15,000 young researchers with non-permanent positions and little opportunity to compete for permanent ones. University work is no longer attractive due to the level of wages, frozen by law since 2011, and the low probability of obtaining a permanent position. With reduced public funding, universities have been under pressure to increase student fees, further reducing new enrolments. The progressive reduction in the budget of the two funds which provide money for basic and “not targeted” research (PRIN and FIRB) is a further limitation of the activities of Italian universities (CUN, 2013).



2011 Italy's index was 89, while the OECD average had increased to 107, France was stable at 101 and Germany reached 110 (ibid., p.234).

### **Developments in University personnel and recruiting**

The ANVUR report on the university and research system (ANVUR 2014) has provided information on the evolution of university personnel. In 2013 total university teaching staff included 53,459 permanent employees – 13,883 full professors, 15,830 associate professors, 23,746 permanent researchers (a category that has now been abolished) – 3,309 fixed-contract researchers (the new entry-level position in the university system) and 24,116 research collaborators – 16,081 'assegnisti di ricerca' and 8,035 collaborators to research projects – that are outside university staff. In 2012, administrative and technical staff included 53,171 employees. Compared to 2008, Italy's universities have lost more than 9,000 permanent teaching staff (1/7 of 2008 personnel), including 5,000 full professors and 2,500 associate professors. This represents an unprecedented weakening of the university system (ibid., p.219).

The ANVUR report shows that – if the retirement trends will continue as in the past – between 2014 and 2018 9,300 units of permanent staff will retire, 1/6 of the total teaching staff; 4,440 full professors will retire, 1/3 of the current personnel (ibid., p.231), Italy's universities are facing a process of 'hollowing out', weakening the country's R&I system and falling behind European standards in a dramatic way.

This decline in university teaching staff is the result of recent government policy and of MIUR's constraints on the possibility for universities to replace professors who retire. In recent years a drastic cut was introduced, allowing only a 20% rate of replacement (1 new professor hired for every 5 professors retiring). The 2014 budget law introduced a gradual increase of this turnover rate from 20% to 60% in 2016, 80% in 2017 and 100% in 2018. At the end of 2014 a MIUR decree set new individual rates for each university introducing extreme differences in the funding available for turnover, with a rate of 500% for the University of Catanzaro, followed by top HEIs such as Scuola Superiore Sant'Anna, SISSA of Trieste and Scuola Normale Superiore and by Università del Foro Italico. In all, nine HEIs are allowed to hire above the 100% replacement of retiring staff; large universities in the North tend to have a better treatment than large universities in the Central and Southern Italy; at the bottom, with a replacement rate still standing at 20% there are many small and medium sized universities, especially in the South. While MIUR had announced a financing system linked to performance, the 'merit' criteria used in this fund assignment is not clear.<sup>25</sup>

With such constraints in employing new university staff – either permanent or with fixed term contracts – the hiring of a large number of post-doctoral research collaborators – in particular the 16,081 'assegnisti di ricerca' – has been the only way for universities to maintain research and teaching activities. Their contract has low wages, weak social protection and can be renewed annually for a maximum of four years. From 2015 on, several thousands of them will reach the maximum of four years in such a position, while

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<sup>25</sup> MIUR, Decreto Ministeriale 18 dicembre 2014 n. 907, Decreto criteri e contingente assunzionale delle Università statali per l'anno 2014, <http://attiministeriali.miur.it/anno-2014/dicembre/dm-18122014.aspx>. An evaluation of the decree is provided by Beniamino Cappelletti Montano, Punti Organico 2014: Robin-Hood alla rovescia, parte seconda, Roars, 02/01/2014, <http://www.roars.it/online/punti-organico-2014-robin-hood-alla-rovescia-parte-seconda>.

the job offerings for fixed-term researchers are likely to be much fewer. Italy's universities, therefore, risk losing a large number of young post-doctoral scholars who will face the alternative of moving abroad or abandoning research activities. Considering the huge investment carried out by universities in the education and training of such personnel, this represents an additional, highly problematic development for the efficiency and effectiveness of Italy's R&I system.

In 2014, the results of the first 'Abilitazione Scientifica Nazionale' (ASN) – a 'Qualification' system for scholars who want to become candidates to positions of Full and Associate professor – were published, and the second round was carried out, with full results available in 2015. The first year of the ASN had 59,150 applications – 18,061 for full professor and 41,089 for associate professor. Candidates could apply to more than one scientific field (the average was 1.47 applications per candidate) and evaluation in each scientific field has been carried out by a Committee composed by four Italian Full Professors with a publication record above the national median and by one foreign expert; members of the Committees have been randomly selected from a list of voluntary candidates and have been in charge also of the second round of the ASN.

An official comprehensive assessment by MIUR of the results of the 'Qualification' is not yet available. Results have been investigated by independent studies (see in particular Marzolla, 2014) that have reported a success rate of 43% for both full and associate professors. In the different groups of disciplines, success rates for full professors ranged from 57% in Agricultural and veterinary sciences to 32% in Political and social sciences; for associate professors they ranged from 57% in Physics to 31% in Political and social sciences. Disciplines were divided between 'bibliometric fields' in the 'hard sciences' where quantitative indicators – journal articles, number of citations received, h-index – were used as benchmarks for the evaluation, and 'non-bibliometric fields' in the social sciences and humanities where number of articles in top journals, total articles and book chapters, and number of books were used as key indicators, with Committees free to identify specific evaluation criteria in each discipline. For each discipline ANVUR calculated for these indicators the scores of each candidate and the median value for all existing professors. Results for 'bibliometric fields' show that among above-median applicants the share of those passing the 'Qualification' was 57% for full professors and 61% for associate professors. Among below-median applicants, success rate was 9 and 11% respectively. For 'non-bibliometric fields' among above-median applicants the share of those passing the 'Qualification' was 44% for full professors and 45% for associate professors. Among below-median applicants, success rate was 7 and 4% respectively (Marzolla, 2014, p.16).<sup>26</sup> In 'bibliometric fields' candidates that were university 'insiders' (already members of faculty) has a success rate of 50% for full professors and 57% for associate professors; non-faculty members had a success rate of 34 and 35%. MIUR reported that more than 1,000 appeals to the administrative tribunal against individual results of 'Qualification' have been filed. Criticism to the results of the 'Qualification' have included, in some cases,

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<sup>26</sup> Preliminary results summarised by ANVUR president Stefano Fantoni in a testimony in Parliament show some discrepancies. By comparing 'Qualification' results with those of the Quality assessment of universities (VQR), Fantoni argued that "70,2% of those 'habilitated' for full professor positions has received from VQR a score between 0.8 and 1 (the maximum) (...). For associate professors this share falls to 64.7%. Therefore I would argue that these results show that the 'Qualification' has proved to be effective in identifying the best candidates, at least to a large extent". Stefano Fantoni, Audizione presso la VII Commissione della Camera dei Deputati sull'abilitazione scientifica dei professori universitari, 12/06/2014, [http://www.camera.it/leg17/1132?shadow\\_primapagina=3831](http://www.camera.it/leg17/1132?shadow_primapagina=3831)

the arbitrary nature of Committee decisions, the favourable treatment – beyond their scientific merit – of ‘insiders’ and of candidates with links to Committee members, the inappropriate nature of quantitative indicators for the social sciences and humanities.

In the second ‘Qualification’ call of 2013 applications were about one third of the previous round; results will be available in 2015. The changes in the ‘Qualification’ procedure introduced by Minister Stefania Giannini include the extension of the duration of the ‘Qualification’ from four to six years, considering the large number of successful candidates and the small number of openings for professor positions; in early 2015 the third round of ‘Qualification’ is expected to start, beginning with the selection of the new evaluation Committees, that will not include anymore a foreign evaluator and will be operating for two years; there will be no more specific deadline for applicants, who will be evaluated on a continuing. The Minister has also announced that the quality of the new recruits of universities, out of those who have obtained the ‘Qualification’ in the previous two rounds, will be evaluated and will contribute to determine the quality-related part of ordinary funds (FFO) granted to universities.<sup>27</sup>

In February 2013 MIUR released the new regulation for doctoral programmes<sup>28</sup> that will be fully implemented by the academic year 2014-2015. The regulation meets the ERA principles of Innovative Doctoral Training and aims to increase quality and attractiveness of doctoral schools in Italy, especially for foreign students; partnerships with foreign universities are also encouraged. Multidisciplinary doctorates are allowed and PhD courses can include interdisciplinary training through common modules. Cooperation with firms is encouraged, including opportunities such as high level apprenticeships with businesses. The typical training for doctorates will include issues related to international research, research organisation and IPRs. MIUR will allocate additional funding according to the performance of doctoral schools on the basis of their research performance, international activities and business partnerships. ANVUR will monitor periodically that each course meets the minimum requirements of the law. In 2014, MIUR released the guidelines for the management of the new doctoral courses but the preliminary final regulations are not available yet.

New regulations on university activities have been produced by MIUR and, increasingly, by ANVUR, covering a wide range of additional issues, including the institutional setting of universities and departments; the requirements for offering university courses; evaluation of activities and ‘accreditation’, etc. (ANVUR, 2014, section I.2.6).

In Chapter 5 an assessment of the output of university research is provided. The study by the Bank of Italy (Montanaro and Torrini 2013) on the public research system, based on official sources such as OECD, Eurostat and ISTAT, has found that, in spite of below-average funding, the output in terms of quantity and quality of scientific publications – mainly resulting from university research – is not far from those of major and better funded European countries such as France. The main problems identified include the limited orientation of the public research system to the economic application of results and to cooperation with firms which, in turn, have problems in integrating in their activities the inputs provided by public researchers (ibid., p.5). They point out the fragmentation of current system and the weak governance structure that limits the ability to identify major objectives; the recent emphasis on evaluation of research cannot be, in their view, a

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<sup>27</sup> MIUR Ufficio Stampa, ‘Università, Giannini: bene lavoro Governo-Parlamento su Abilitazione scientifica nazionale’, 25/07/2014, <http://hubmiur.pubblica.istruzione.it/web/ministero/cs250714>.

<sup>28</sup> D.M. 8 February 2013 n.94.

substitute for the lack of a strategy: “no evaluation activity, however, can replace the definition of clear objectives on whose basis a long term strategy can be built” (ibid., p.6).

In fact, a more general concern has recently emerged on the balance within the governance system of the university and research system. The role of ANVUR has grown rapidly and now includes the evaluation of research, universities, departments, doctorate programmes; the accreditation of courses and monitoring of university activities; the setting of the bibliometric context for the ‘Qualification’ process; an advisory and monitoring role in a variety of fields. A growing discussion has emerged on its role and Minister Stefania Giannini has clarified in her audition to the Parliament in 2014 that the activity of ANVUR “has led to a delicate balance between the power of direction of the Ministry and the powers of accreditation and evaluation of the Agency (...). We have to avoid the risk that the Agency exercises an ex-ante control, and we have to strengthen its role as an ex-post evaluator<sup>29</sup>”.

### **The brain drain of Italian researchers**

The combination of cuts in university funding and staff, fall in research funding, weakness in business R&I activities and the effects of the economic crisis have resulted in a dramatic fall in the employment opportunities in Italy for researchers and, more generally, highly skilled personnel. While there is no systematic study available, strong fragmentary evidence suggests that Italy is experiencing a process of ‘brain drain’ that could permanently damage its R&I system. While several studies have identified the potential benefits of an extensive international experiences of scholars, a research system that is capable to produce high quality researchers but fails to employ them in order to advance its competences and obtain economic benefits can hardly be sustained in the long term (Ideaconsult 2013a, 2013b).

Official data on the emigration of highly skilled Italians are provided by ISTAT<sup>30</sup>. In 2013 about 19,000 Italian graduates migrated to foreign countries, 30% of the total migration outflow; in 2011 they were about 10,000<sup>31</sup>; in 2008 they were estimated at 6,500. This growing outflow of graduates expands a stock of Italian researchers abroad that is substantial.<sup>32</sup>

A more specific study by ISTAT on 18,000 PhDs from Italian universities who obtained their title between 2004 and 2006 found that 1,300 (7%) worked abroad in 2009 and 2010 (ISTAT, 2011). If only PhDs carrying out research activities are considered, the share grows to 10%. The share was much higher for PhDs in physics (22.7%), followed by mathematics and computer science (ibid. p.5-7). The share has increased rapidly in more recent years.

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<sup>29</sup> Linee Programmatiche del Ministro Stefania Giannini, Audizione presso la VII Commissione della Camera dei Deputati, 24 aprile 2014,

[http://www.camera.it/leg17/1058?idLegislatura=17&tipologia=audiz2&sottotipologia=audizione&anno=2014&mese=04&giorno=24&idCommissione=07&numero=0010&file=indice\\_stenografico#stenograficoCommissione.tit00030](http://www.camera.it/leg17/1058?idLegislatura=17&tipologia=audiz2&sottotipologia=audizione&anno=2014&mese=04&giorno=24&idCommissione=07&numero=0010&file=indice_stenografico#stenograficoCommissione.tit00030)

<sup>30</sup> ISTAT (2014) Migrazioni internazionali e interne della popolazione residente Anno 2013, Rome, 09/12/2014.

<sup>31</sup> ISTAT (2012) Migrazioni internazionali e interne della popolazione residente Anno 2011, Rome, 28/12/2012.

<sup>32</sup> Journalistic estimates put the total number of Italian researchers working abroad at about 50,000, the same order of magnitude of all permanent teaching staff of Italian universities.

The OECD Science Technology Industry report (OECD 2014) provides additional specific evidence on the emigration of Italian researchers. An indicator is developed that tracks changes in the institutional affiliation of scientists who publish in scholarly journals. In the period 1996-2011, 2,500 researchers have changed their affiliation from an Italian institution to a foreign one. Considering the limitations of the database available, this is evidence of a serious outflow of productive scholars.

A few policy measures have been introduced in order to facilitate the return of Italian scholars abroad, including the "Rita Levi Montalcini" and "Messaggeri" programmes. In 2013 MIUR assigned €5m to the "Rita Levi Montalcini programme for young researchers" targeted to young Italian and foreign scholars who have obtained their Ph.D. less than six years before and have been employed abroad in research or teaching jobs for at least three years. Italian universities can offer them non-renewable temporary employment contracts of three years' duration. The 2012 call awarded 24 of such positions.<sup>33</sup> The "Messaggeri" programme financed in 2013 with €5.3m - drawn from Cohesion funds - teaching projects of Universities in the regions of Calabria, Campania, Puglia and Sicilia involving scholars affiliated to non-Italian universities.<sup>34</sup>

There is an evident gap between the policy initiatives carried out and the size of emigration of researchers problem. More systematic data on Italy's 'brain drain' are needed, but this has emerged as a crucial challenge for Italy's R&I policies.

## **Public support for firms' R&D**

Government action has addressed the need to support firms' R&D with a series of measures, which are reviewed in this section; Chapter 4 on the Innovation Union offers details on specific dimensions of such efforts, including the framework conditions for the operation of firms, knowledge transfer and access to finance issues.

A first form of public support for firms R&D has concerned tax credits for R&D that have become in recent years a recurrent element of Italy's policies, although with limited funding and frequent changes of regulations and procedures. In 2013, the Letta's government introduced an incremental R&D tax credit on a permanent basis in order to provide stability to firms' business plans and to enlarge the scope of tax credit policy. The Law 9/2014 detailed the eligibility criteria and the budget for the new R&D tax credit scheme. The available resources are €600m for the period 2014-2016 but the measure is not yet effective since the Ministry regulation is still missing. In 2011, the government had launched tax credits schemes for businesses financing research projects in partnership with universities or public research entities and for firms employing highly skilled workers in innovation and research. The resources for businesses financing university research projects were €55m in 2011, €180.8m in 2012, €157.2m in 2013 and €91m per year from 2014 onwards.<sup>35</sup> R&D tax credits for firms employing highly skilled workers in innovation and research were financed with €25m in 2012 and €50m from 2013.<sup>36</sup> The 2015 stability law changed the tax credit regulation according a total budget of €600m for three years. The secondary regulation, required by the stability law has not been released yet. Also the fund for financing tax credits for businesses and networks of companies ('Reti

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<sup>33</sup> <http://www.cineca.it/en/news/rita-levi-montalcini-program-young-researchers>

<sup>34</sup> <https://messaggeri.cineca.it/>

<sup>35</sup> Law 12 July 2011 n.106

<sup>36</sup> Law Decree n. 83/2012.



d'impresa') - introduced by the 2013 budget law - has not been implemented yet. Cantabene and Nascia (2014) have assessed the effectiveness of R&D tax credits provided in the period 2007-2009, finding some additionality of public and private funds

A second policy tool for supporting firms' R&D is the direct funding of business projects. As documented in the previous ERAWATCH Country Report 2013 (Nascia and Pianta 2014) and in ANVUR (2014, p.430), the main fund for this aim is the FIRST (Fondo per gli investimenti nella ricerca scientifica e tecnologica) that supports the FAR (Fondo per le agevolazioni alla ricerca), as well as funds mainly directed towards universities and PROs such as PRIN (Progetti di interesse nazionale) and FIRB (Fondo per gli investimenti nella ricerca di base). The FAR also contributes to the co-financing with MISE of the PONREC projects (Programma operativo nazionale Ricerca & Competitività). The Department of Development and Social Cohesion (DPS) within MISE is in charge of the use of EU Structural Funds; the new 'Agency for territorial cohesion', created at the end of 2013, is still not operational but in the near future will become a key in the management of structural funds.

In March 2013,<sup>37</sup> MISE reformed the system of firms' incentives with the objective to target innovation for competitiveness and support investments in enabling technologies. Firms' incentives are financed by the "Fondo per la Crescita Sostenibile" (FCS) that will include all the resources for technological innovation. FCS is closely linked to Horizon 2020 guidelines and definitions. It replaces the previous "Fondo rotativo per sostegni alle imprese e gli investimenti in ricerca" (FRI), simplifying regulations and redefining the scope, the beneficiaries and the mix of the incentives that will be available for indirect financing. In September 2014 MISE issued the call for industrial R&D projects of the FCS, covering the fields of ICTs, nanotechnology, advanced materials, biotechnology, advanced manufacturing, technologies associated to the EU Horizon 2020 programme. Available funds amount to €300m, 60% earmarked for SMEs. Funds are provided in the form of low interest loans.<sup>38</sup> An additional discussion of the funding available for R&I is provided in section 2.5.3 below.

Funding for R&I in Italy have moved towards thematic or targeted projects. This is the case of all the above programmes as well as of the Industrial Innovation Projects (PIIs)<sup>39</sup> and of the National Technology Clusters programme for technology transfer.<sup>40</sup> The National Technology Clusters are organised aggregations of companies, universities, other public or private research organisations active in the field of innovation, focusing on eight technology fields. The programme, launched in 2012, has financed 48 projects with €266m.

The Smart Cities call of 2012 targets the four Cohesion Regions: Sicily, Calabria, Puglia and Campania.<sup>41</sup> It aims to involve SMEs, large firms, universities and PROs in innovative projects on social innovation for nine strategic areas in line with the Horizon 2020 Societal

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<sup>37</sup> MISE D.M. 8th March 2013.

<sup>38</sup> [http://www.sviluppoeconomico.gov.it/index.php/it/?option=com\\_content&view=article&viewType=1&idarea1=593&idarea2=0&idarea3=0&idarea4=0&andor=AND&sectionid=0&andorcat=AND&partebassaType=0&idareaCalendario1=0&MvediT=1&showMenu=1&showCat=1&showArchiveNewsBotton=0&idmenu=2263&id=2031108](http://www.sviluppoeconomico.gov.it/index.php/it/?option=com_content&view=article&viewType=1&idarea1=593&idarea2=0&idarea3=0&idarea4=0&andor=AND&sectionid=0&andorcat=AND&partebassaType=0&idareaCalendario1=0&MvediT=1&showMenu=1&showCat=1&showArchiveNewsBotton=0&idmenu=2263&id=2031108)

<sup>39</sup> MISE D.M. 15th May 2012 <http://www.sviluppoeconomico.gov.it/index.php/it/incentivi/impresa/progetti-di-innovazione-industriale>

<sup>40</sup> MIUR, D.D. 30th May 2012 n. 257.

<sup>41</sup> D.D. 5th July 2012 n. 391/Ric.

Grand Challenges. After the selection phase, eight projects were awarded with a total funding of €200m.

As documented in the ERAWATCH Country Report 2013 (Nascia and Pianta, 2014) growing attention has been devoted to the 'Smart specialisation strategy', ('Support and definition of regional R&I policies') for Italian regions, launched in 2013 by MISE in cooperation with MIUR. The project supports regions by providing information, surveys and statistics, supporting knowledge transfer from best performing regions, sharing methods and tools and ensuring consistency at national level. The project is based on the consultation of stakeholders at the regional level – both institutions and private business – aiming at identifying an effective Smart specialisation strategy. In October 2013 Invitalia, the operational arm of the project, released a first mapping of sectoral specialisations. The governance structure relies on the central government to coordinate regional efforts and specialisations, while regions propose their strategy and offer feedbacks to national initiatives. The project has defined regional specialisations, the set-up of indicators and the design of the supporting actions to each S3 regional strategy,

The initiatives examined above are generally targeted towards the same thematic areas of EU programmes, such as Horizon 2020, the seven European Grand Societal Challenges or the European Digital Agenda, with a strategy of integration between national and EU R&I priorities. However, Italian GBAORD data in 2012 and 2013 indicate a small reduction in the share of thematic priorities compared to 2011<sup>42</sup>.

### ***2.3 National Reform Programmes 2013 and 2014***

Both the National Reform Programme (NRP) 2013 and 2014 highlight the efforts made to reach the Europe2020 targets in a framework of financial stabilisation. The key target for the R&I system is the increase of R&D intensity, but little progress has been made in the last two years.

#### **National Reform Programme 2013**

The NRP 2013 argues that the target of greater transparency has led to the reform of research incentives; the creation of the "Fondo per la Crescita Sostenibile" and other measures have streamlined the funding of strategic projects in coherence with Horizon 2020. Similar improvements have been made in the ordinary funding of PROs (FOE), ensuring the funding of the flagship projects described in the PNR.

In the field of territorial cohesion, the government achieved relevant results by financing with €915m initiatives as high-tech clusters, network of innovative firms, public-private partnership projects and a specific call for strengthening R&I in Objective 1 Regions – Campania, Calabria, Puglia, Sicily. The NRP 2013 details the initiatives for promoting start-ups and innovative firms, which are considered crucial for achieving higher competitiveness. The documents also emphasises the release of the HIT2020 document which outlines the strategies for the R&I system until 2020 in the framework of Horizon2020.

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<sup>42</sup> Data are from Eurostat (2014). The share of GBAORD expenditures for specific priorities decreased from 64.4% in 2011 to 63.6% in 2012 and 58.5% in 2013. GBAORD recorded an overall reduction, both in real and nominal values in the same years.

A specific section of NRP 2013 stresses the results achieved on Structural Funds. In 2012, Italy had strongly improved past performances in the design of projects, spending of resources and compliance with the reprogramming for 2007-2013. The Smart Specialisation Strategy is a key initiative for the use of structural funds for R&I.

### **National Reform Programme 2014**

The National Reform Programme for 2014 (NRP 2014) highlights recent efforts made by the government on R&I and on the achievement of Europe 2020 targets. The long list of policy measures aiming to trigger investments in R&D broadly follows the NRP 2013 approach. The document stresses progresses made in university financing and recruitment, the streamlining of public funding, the new indirect incentives for R&D investing firms, social innovation calls and the alignment with the EU research priorities. Two laws (D.L. 36/2014 and D.L. 104/2013) regulated the procedures detailed in the paragraph 2.2 for the recruitment of university professors. Within the FFO institutional funding to HEI, a growing share has been attributed on the basis of universities' performances in education and research, and on the basis of the results of the quality assessment review published by ANVUR in 2013 (ANVUR 2013). According to the NRP 2014, the government envisages a further increase of the share of university funding based on performing criteria in the next years.

As already mentioned, FAR, FCS and FIRST have become the major instruments to finance industrial research and innovation in firms, within the Horizon2020 framework. According to the NRP 2014, MIUR is still implementing the 2012 FIRB call and a new call is envisaged in 2014 (but it was not yet launched at the end of 2014). The PRIN 2012 call closed the selection process in 2013 and no other calls are envisaged in 2014. In 2014 the new programme SIR (Scientific Independence of Young Researchers) launched a first call to finance young researchers.

NRP2014 highlights the progress made in the management of the National Operational Programme for Research and Competitiveness 2007-2013 (PONREC) which is expanding its relevance and it is the major instrument for innovation and research policies in Objective 1 regions - Campania, Calabria, Puglia, Sicily -, for social innovation and for public-private partnership. In 2013, the Government launched a call for the implementation of new research infrastructures also in the framework of PONREC.

However, at the end of 2014 some relevant measures were not yet operational. The new doctoral courses, the new PNR and the Agency for Territorial Cohesion are not yet fully implemented.

### ***2.4 Policy developments related to Council Country Specific Recommendations***

The European Council Country Specific Recommendations in 2014 refer to the public funding of the HEIs and PROs. Recommendation focus on the allocation of the public funding of HEIs that should be managed to reward the quality and performance of HEIs and PROs. Since 2012 public funding increased the share of the institutional block fund allocated in accordance with performance indicators. As pointed out in par 2.2 the 2014



FFO allocation includes 18% of resources earmarked for 'better performing' universities increasing the degree of differentiation of funding across HEIs.

Although the budget law 2015 increased the FFO of €150m, the actual additional funds, after some years of budget cuts, are far below the official figure, as discussed in par 2.2. The CUN argued in a document that the financing for 2014 is basically unchanged from 2013, warning that "the context of continuing reduction of financial and human resources will bring Italy's university system to an irreversible crisis" (CUN, 2014).

These steps continue the recent policy of strengthening the mechanisms differentiating university funding on the basis of performance indicators. The role of ANVUR in this context continues to increase. While these measures are likely to improve efficiency in resource allocation, when combined with the overall underfinancing of higher education and the continuing fall in staff numbers, they may increase the difficulties met in particular by smaller universities. The effects of the above mentioned measures on the research capacity and on the education quality are not yet clear.

## **2.5 Funding trends**

### **2.5.1 Funding flows**

Italy's Europe2020 target for R&D investment is a 1.53% ratio of R&D expenditure to GDP. Current policies have not been able to significantly improve this indicator, which in 2013 was equal to 1.25% – in spite of the continuing fall of Italy's GDP. The ratio was 1.26 in 2012 and has remained broadly stable (ISTAT, 2014a). In 2013 and 2014 Italy continued to reduce public expenditure while business R&I expenditure has been contained by the economic depression.

The research and innovation (R&I) system of Italy has been seriously affected by the economic depression that has hit the country since 2008. After the slump of 2009 (-5.5% in GDP), Italy's GDP stagnated in 2011 (+0.4%), fell in 2012 (-2.3%), 2013 (-1.9%) and in 2014 (-0.3%). This fall in GDP follows a decade when growth and economic performance were below the EU average.

According to ISTAT official data, total intramural expenditure on R&D (GERD) were €20.5bn in 2012, with a 1.9% increase in real terms over 2011. Preliminary data for 2013 report a 2.9% fall in real terms over 2012. A further fall of 1.9% in public R&D and a 1.4% increase in firms' expenditure is expected by ISTAT for 2014 (ISTAT 2014a, p.1). Total R&D personnel (in full time equivalent) in 2013 were 253,000, with a 5.2% increase over 2012. Researchers were 118,000, 6.6% more than in 2012.

Italy's GERD per capita in 2013 is €338.5, lower than the EU-28 average (€539.2). In order to reach the Europe2020 target the yearly R&D investments should increase – assuming a constant GDP – by €4bn, an amount far from the resources made available by present policies.

Considering the evolution of GERD in real terms since the start of the crisis in 2008, we find a limited decline and an overall stability in its composition; in 2013 GERD was mainly performed by the private business sector (54%), followed by higher education institutions (28.2%) and the public sector (14.9%). In terms of Government R&D appropriations (GBAORD), expenditure recorded a continuing fall from €9,711m in 2009, to €8,824.9m in 2011, to €8,822m in 2012 to €8,324m in 2013 (ibid., p.6).

Research funding from abroad – both private and public, including EU funds – has become a significant source for Italy's R&I, reaching 0.12% of GDP in 2012. The funding flows from abroad are originated by three relevant sources: FDI-associated R&D, EU Framework Programmes and EU Structural Funds. Framework Programmes (FP) are becoming a relevant channel for the European funding of research in Italy. The participation to FP7 calls is widespread with a success rate of Italian proposals of 18.3%. Italy is the fourth highest financed country in FP7 (more than €3.5bn from 2007 to June 2014)<sup>43</sup>, after the UK, France and Germany; business participation is strong, with nine Italian firms among the top 50 recipients of signed grants in 2007-2011<sup>44</sup>.

Data on Italy's participation to EU FP6 and FP7 projects – based on elaborations on RIO data by the European Commission - show for the former 3,244 projects approved with 6,836 participants and an EU financial contribution of €1.5bn. In FP7 approved projects were 6,295 with 11,893 participants and an EU financial contribution of €3.6bn.

EU Structural Funds co-finance the National Operational Programme 'Research and Competitiveness' (PONREC), which has been funded with €4,424.3m for 2007-2013<sup>45</sup>. The integration of research and innovation as a pillar of such initiatives and the joint management by MIUR and MISE of the PONREC has led to an increase in the R&I dimension in the local development and social cohesion policies. PONREC granted funds for €4,599m to 3,154 projects in the period 2007-2014<sup>46</sup> in Italy's four Objective 1 regions (Calabria, Campania, Puglia and Sicily). PONREC is the major instrument for the implementation of measures for innovation and industrial R&D. Strategic documents consider PONREC as a key driver for the improvement of the R&I system. The objective of PONREC is to increase the competitiveness of the four regions through progress in R&I as a source of higher competitiveness for the entrepreneurial system. The joint management by MIUR and MISE ensures the focus both on R&D than on technology transfer to businesses.

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<sup>43</sup> [http://ec.europa.eu/research/fp7/index\\_en.cfm?pg=country-profile](http://ec.europa.eu/research/fp7/index_en.cfm?pg=country-profile)

<sup>44</sup> Fifth FP7 Monitoring Report 2011 29/08/2012

<sup>45</sup> Available resources were reduced in October 2012 after the reprogramming round of MISE and MIUR. The funding from the European Regional Development Fund (ERDF) is €3,102m. The budget available can be downloaded from <http://www.ponrec.it/programma/risorse-finanziarie>.

<sup>46</sup> <http://www.ponrec.it/open-data/progetti> Data updated on 31/08/2014.

**Table 1 Basic indicators for R&D investments**

	<b>2009</b>	<b>2010</b>	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>EU28 (2013)</b>
GDP growth rate	-5.5	1.7	0.4	-2.4	-1.9	0.10%
GERD (% of GDP)	1.22	1.22	1.21	1.26	1.25	2.02%
GERD (euro per capita)	325.6	331.6	333.7	345.2	338.5	539.2
GBAORD - Total R&D appropriations (€ million)	9,778.4	9,548	9,161.4	8,822.3	8,323.9	90,505.6 1
R&D funded by Business Enterprise Sector (% of GDP)	0.52	0.53	0.53	0.54	N/A	1.1% (2012)
R&D funded by Private non-profit (% of GDP)	0.04	0.04	0.04	0.04	N/A	0.03% (2012)
R&D funded from abroad (% of GDP)	0.12	0.12	0.11	0.12	N/A	0.2% (2012)
R&D related FDI (*) (€ million)	2,498	N/A	1,887	N/A	N/A	n/a
R&D performed by HEIs (% of GERD)	30.3%	28.8%	28.6%	28.0%	28.2%	23.19%
R&D performed by Government Sector (% of GERD)	13.1%	13.7%	13.4%	14.8%	14.9%	12.21%
R&D performed by Business Enterprise Sector (% of GERD)	53.3%	53.9%	54.6%	54.2%	54.0%	63.76%
Share of project vs. institutional public funding for R&D	N/A	N/A	N/A	N/A	N/A	n/a
Employment in high- and medium-high-technology manufacturing sectors as share of total employment	6.0	5.8	5.8	5.9	5.9	5.6%
Employment in knowledge-intensive service sectors as share of total employment	33.6	33.7	33.8	33.5	33.9	39.2%
Turnover from innovation as % of total turnover	9.8% (2008)	8.0%	n/a	n/a	n/a	13.4% (2010)

### **2.5.2 Project vs. institutional allocation of public funding**

In 2013 and 2014 the major changes in public funding regarded the allocation of funding for HEIs and the streamlining of direct incentives to firms. Both are investigated in detail in section 2.2 above. The share of institutional funds has been rapidly declining, while funds based on performance have increased their relevance for HEIs. Policies supporting firms' R&D include on the one hand tax incentives for R&D that operate across the board and, on the other hand, projects that are allocated on a competitive basis (FAR and FCS funds). Regulations for allocating these resources have been revised in 2012, 2013 and 2014 in order to streamline the modalities of access. Overall, a continuing shift from the dominance of institutional funding of R&D towards funding based on performance or on projects is clearly visible.

The provision of resources for both institutional and project funds is regulated by the annual budget law, that has been heavily affected by public spending cuts. The budget law allocates resources for R&I policies on a three-years period, but only the budget for the first year is mandatory, while the plans for the second and third year can be amended by

the next budget laws. Uncertainty in resource availability has been a further problem for both institutional and project funding of R&D efforts<sup>47</sup>.

### **2.5.3 R&I funding**

The structure of expenditure for R&D in Italy shows about a quarter of funds going to upstream basic research, half going to applied research and a quarter going to experimental development (ISTAT 2014, p.3). Funds for more 'downstream' activities of introduction of innovations to markets, knowledge transfer and technology diffusion are provided by the specific programmes described in section 2.2. In particular, the joint management by MISE and MIUR of initiatives such as PONREC and Smart Specialisation, extends funding opportunities over the entire R&I process.

In order to address the traditionally low effort by firms in R&I funding, recent policies – in particular HIT2020 – have aimed to use public funding in order to trigger private investments in R&D, especially for the funding streams managed by MISE, and encourage cooperation between private business and public institutions.

As already pointed out in section 2.2, tax credits have been an important part of R&I policies. They have evolved rapidly from a general R&D tax credit in 2007, to a tax credit allocated through the 'click day', a selection process that awarded funds to firms according to the arrival order of the online application for the years 2008 and 2009. In 2010 tax credits were not available and have been reintroduced in 2011, limited to companies funding R&D projects in collaboration with HEIs and PROs. At the end of 2013 the government reintroduced a general tax credit scheme based on incremental expenditures. The many and frequent changes in the system of indirect incentives and the frequent delays due to bureaucratic procedures, however, have created uncertainty for business investment, whose long term perspective would require advanced information on a stable system of incentives.

The Start-up law has been the latest step towards the creation of innovation-oriented firms; it makes available innovative modalities of financing, tailored for innovative SMEs, such as crowdfunding (operational from 2013), payments in equity shares for key suppliers and stock options for SMEs personnel, as well as streamlined access to collaterals for bank credits (operational from 2014).

## **2.6 Smart Specialisation (RIS3)**

In 2013 the agency INVITALIA managed in accordance with the commitment of MISE in cooperation with MIUR the project 'Support and definition of regional R&I policies (Smart Specialisation Strategy)' to define the Smart Specialisation Strategy for Italian regions under the guidelines of the RIS3.

The project is focused with the programming documents for the 2014-2020 EU funding cycle. The action plan identifies public-private partnerships as a modality to trigger private investments. The project structure is based on monitoring and evaluation methods for the whole period 2014-2020.

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<sup>47</sup> This was stressed by Minister Stefania Giannini in her audition to the Parliament in April 2014.

The project supports regions by providing information, surveys and statistics, supporting knowledge transfer from best performing regions, sharing methods and tools and ensuring consistency at national level. The approach to design Smart Specialisation Strategies relies on a open and inclusive view. Relevant stakeholders at the regional level - both institutions than private business – have been involved to contribute to the identification of an effective smart specialisation strategy. The operational methodology included SWOT and proximity analyses at the regional level and local initiatives harmonisation. In October 2013 Invitalia released a first mapping of sectoral specialisations which will contribute to the design of the regional and national strategy, that have been finalised at the end of 2014.

## ***2.7 Evaluations, consultations, foresight exercises***

In 2013, the more relevant evaluations of Italy's R&I system included three documents: Horizon 2020 Italia Ricerca e Innovazione (HIT2020, MIUR 2013), the ANVUR research quality assessment (VQR, ANVUR 2013) and the report by CUN on universities (CUN 2013). The ERAWATCH Country Report 2013 (Nascia and Pianta 2014) already examined the findings of such studies.

In 2014 the most important evaluations included the ANVUR report on the university and research system (ANVUR 2014) and a study of the Bank of Italy on the public research system (Montanaro and Torrini 2013); both are referred to in the relevant parts of this report.

### **3. National progress towards realisation of ERA**

#### ***3.1 ERA priority 2: Optimal transnational co-operation and***

At national level MIUR is in charge for the management of the Italian participation in international initiatives such as European Framework Programmes and for the participation to any international activity regarding research, coordinating the participation of other ministries. As indicated in HIT2020 and confirmed in the PNR 2014-2020, Italian research policy is oriented to support joint activities with EU countries.

Transnational research collaborations are managed on the basis of bilateral and multilateral agreements. In 2014 Italy was involved at the EU level also in the participation and co-funding of 11 ERANET initiatives<sup>48</sup> and of the new 6 Joint Technology Initiatives released by the European Council meetings of May and June 2014. Italy is in charge of the coordination of the JPI Cultural heritage financed in 2014, within the JPI Cultural Heritage framework, a competitive joint project call for €4.75m. In the years 2013-2014 MIUR has financed calls within the framework of three art.185 programmes too.

The policy for a higher degree of international cooperation is stressed also by major strategic documents.

HIT2020 supports the target of increasing the Italian participation in transnational research programmes. It envisages a tuning of domestic research policy according to EU programming also with the inclusion of the EU agenda research priorities into the national framework embracing joint programming. Finally, the strategic document of MIUR for 2014<sup>49</sup>, indicates internationalization as a priority for the research system.

In 2012 the introduction of some policy novelties<sup>50</sup> removed some legal and bureaucratic barriers hampering the effectiveness of international cooperation. Namely, Law 35/2012 and Law 134/2012 simplified the rules of research projects adopting definitions and eligibility of costs on the basis of the EU legislation, created the legal basis for the domestic recognition of evaluation of international scientific projects selected by EU programmes and stated that the national ex ante evaluation of the scientific suitability of a project can be replaced by international evaluation of selected projects in EU programmes regardless the evaluation methods adopted by the international programmes.

From 2012 on MIUR competitive funding calls adopt standard forms<sup>51</sup>, the ERC definitions of scientific sectors and full cost accountancy system for research projects. In March 2013, MIUR amended the procedures for financing Italian projects selected by international research programmes which recognize international evaluations. According to HIT2020 the introduction of the new procedures will be progressively extended to all MIUR calls.

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<sup>48</sup> Source: MIUR website, <http://www.ricercainternazionale.miur.it/era/eranet-e-sa.aspx> The figure includes also the indirect participation with some controlled institution.

<sup>49</sup> MIUR (2014b) [http://www.istruzione.it/allegati/2014/prot1\\_14.pdf](http://www.istruzione.it/allegati/2014/prot1_14.pdf)

<sup>50</sup> Law 35/2012 and law 134/2012.

<sup>51</sup> PRIN and FIRB calls adopt standardised forms for the project evaluation since 2012.

## **3.2 ERA priority 3: An open labour market for researchers. Facilitating mobility, supporting training and ensuring attractive careers**

### **3.2.1 Introduction**

The labour market for researchers is traditionally highly regulated with different rules between public institutions and private business. The majority of HEIs and PROs are public institutions and fall under national laws and national collective agreements for recruitment, pay, mobility, training and careers. In HEIs permanent researchers' contracts are regulated by law, in PROs in part by law and in part by collective agreements. As discussed in Chapter 2, according to ISTAT, in 2012 the total number of researchers was around 110,000 FTE units, mainly allocated in HEIs (45,000 units), private business, (41,000 units) and PROs (20,500 units)<sup>52</sup>.

### **3.2.2 Open, transparent and merit-based recruitment of researchers**

Law 1/2009 and Law 240/2010 regulate the recruitment of researchers and introduced major changes into the research system. As discussed in Chapter 2, since 2012 HEIs recruitment is based on the national 'Qualification' process<sup>53</sup> which is designed to follow the criteria of transparent, open and merit-based recruitment. Foreign candidates and non-residents can access universities and research institutes through public selections on equal footing with Italian citizens. Moreover, national regulations allow the direct recruitment of a limited number of external researchers (high-level scholars) in permanent positions.

According to Laws 1/2009 and 240/2010, young researchers in HEIs and PROs can apply only to temporary positions with a tenure track-like path<sup>54</sup>. Law 240/2010 introduced evaluation as key element for salary improvements of researchers and professors, but since 2011 budget laws have stopped any wage increase in the public sector, including universities and public research organizations. Budget laws of the last years reduced the opportunities for young researchers though some changes<sup>55</sup> were included in the 2014 budget law<sup>56</sup>. The joint effect of laws 1/2009 and 240/2010 on recruitment have not been evaluated yet. Nonetheless, the inclusion of budget cuts too are bringing HEIs and PROs to a scarcity of permanent positions and to an increase of temporary positions, as indicated in par. 3.2.1. Thus, the labour market of researchers is moving towards a situation of scarce inflow of young scholars and slowdown of career advancements for the insiders.

According to a survey by FLC-CGIL<sup>57</sup>, the largest trade union in the research sector, the outlook for young researchers is negative<sup>58</sup>. In 2013 and 2014 HEIs recruited researchers

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<sup>52</sup> 3,900 researchers were employed in private non-profit institutions.

<sup>53</sup> See chapter 2 for details on the 'Qualification' system. Before the reform the recruitment system relied on internal selection panels which created an advantage for internal competitors.

<sup>54</sup> The 2015 stability law in the art.39 limited the tenure track positions in favour of temporary contracts.

<sup>55</sup> Additional sources for recruitment and some derogation to the permanent prohibition to recruit new personnel to the public sector. See chapter 2 for details.

<sup>56</sup> Resources for the recruitment are budgeted into the block funds that finance universities (FFO) and research institutes (FOE). The budget law 2014 softened some recruitment constraints as discussed in chapter 2.

<sup>57</sup> Ricercarsi survey, December 2014. <http://www.flcgil.it/sindacato/documenti/approfondimenti/presentazione-indagine-flc-cgil-ricercarsi-dicembre-2014.flc>

for only 258 new positions with a tenure track path<sup>59</sup>. The number of outflows of professors and researchers is much higher than the inflows<sup>60</sup> and the resulting projection is a downsizing of the whole system with negative effects on teaching activities. The negative outlook for young researchers can turn into a widespread mobility towards foreign research institutions. According to the above mentioned FLC-CGIL survey 60% of doctorates are expected to leave Italy in the next years.

### **3.2.3 Access to and portability of grants**

Access by non-residents to national grants is still limited. Only some calls allow the participation of researchers of foreign institutions. The programme 'Rita Levi Montalcini', targeted to attract young researchers from abroad regardless their nationality has been the first opportunity earmarked for researchers of foreign institutions<sup>61</sup>. The programme started in 2009 and the last 2013 call made available 24 job positions<sup>62</sup>. The FFO for 2013 allocated €10m for financing the programme calls in 2012 and 2013.

In 2014 the first SIR (Scientific Independence of young Researchers) call allowed the participation of foreign institutions, but only in partnership with resident institutions, with an available budget lower than 50% of the grant. The total budget of the call is €47m. In general, access to national funding calls is closed to foreign researchers or limited to their cooperation with resident researchers, as in the case of FIRB calls. The 'Qualification' for professors was open to foreign citizens and also allowed an English language procedure.

Until 2012 the portability of research grants into other national institutions was limited, while transfer to foreign institutions was not allowed. In 2012 Law 35/2012 removed legal barriers to allow grant portability. Law 35/2012 allows researchers, in case of participation to international projects, to leave their employer for the whole duration of the project (if they work at the employer's office) or for a maximum period of 5 years, if they change the location of their activities. The aim of the law is to streamline the procedures for grant portability at national and foreign level.

### **3.2.4 EURAXESS**

Since 2004 CRUI, the conference of Universities Rectors, is the bridgehead body for the activities of the national Euraxess network. In general, the online points provide updated information for ingoing and outgoing researchers while offices are able to provide tailored services. Since 2011 the Euraxess network makes available a web site, seven service offices and ten contact points in the national territory. The website <http://www.euraxess.it>, is jointly managed by CRUI, University of Camerino and AREA Science Park, and is a primary resource for mobile researchers. Since 2013 the website is integrated into the official MIUR website 'ResearchItaly'. It provides updated (not tailored) information on vacancies, fellowship and on logistic issues. The contact points' network makes tailored services available to mobile researchers. The geographical allocation of the contact points shows a concentration in Central and Northern Regions of the country with a scarce

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<sup>58</sup> According to an elaboration of the survey on MIUR data less than 10% of temporary researchers turned into permanent contracts.

<sup>59</sup> They are called B type contracts.

<sup>60</sup> The CGIL survey, which adopts MIUR data, indicates 141 inflows and 2,324 retirements from HEIs in 2014.

<sup>61</sup> Actually, the programme is aimed to attract Italian researchers living abroad in order to tackle with the brain drain issue.

<sup>62</sup> The previous call in 2012 made available other 24 positions.



presence in Southern regions. Eleven universities activated offices for foreign mobile researchers, offering tailored information. CNR, the largest PRO in Italy, manages an Euraxess contact point providing tailored information for mobility. Euraxess offices provide mobile researchers and their families with information and support in all mobility related matters at national or local level, including assistance on administrative procedures (i.e. visas), accommodation and logistic issues. At the national level no specific budget lines are available for Euraxess.

### **3.2.5 Doctoral training**

According to MIUR figures<sup>63</sup>, doctoral courses are attended in 2014 by more than 33,000 students. In the academic year 2013-2014 for the XXVII cycle 11,846 students passed the selection for doctoral courses but only 1,487 were foreign citizens.

Doctoral courses fall under national regulation especially for the access modalities; according to law 240/2010 HEIs have a large degree of autonomy for the management and the organization of doctoral courses. Law 240/2010 included a deep change in the organisation of doctoral training but it needs a MIUR regulation (secondary regulation), released in February 2013 but still under discussion. A new type of doctorate courses, called 'industrial doctorates', are not yet operational but some steps towards their introduction have been made at local level<sup>64</sup>. The delay in the implementation of the doctorate reform is due also to issues related to the required additional resources. An ANVUR assessment on doctoral courses is in progress<sup>65</sup>.

The new regulation of doctoral courses meets the ERC principles of innovative doctoral training and aims to increase quality and attractiveness of doctoral schools in Italy, especially for foreign students; partnerships with foreign universities are also encouraged. Multidisciplinary doctorates are allowed and Ph.D. courses can include interdisciplinary training through common modules with a special focus for the development of the so called 'soft skills'. Cooperation with firms is encouraged, including opportunities such as high level apprentices within the business world. The typical training for doctorates will include issues related to international research, research organisation and IPRs. MIUR will allocate additional funding according to doctoral schools' research performance, international activities and business partnerships<sup>66</sup>.

ANVUR will monitor periodically that each course meets the minimum requirements of the law. On January 2014 a commission of MIUR has released the operational regulation for the new doctoral courses. PNR 2014-2020 - not yet approved by the CIPE - envisages the promotion of innovative doctoral courses (i.e. Industrial doctorates), with the programme 'Mille e più dottorati innovativi' which will promote innovative solutions for at least 1,800 doctoral students each year with an yearly budget of around €60m. Also HIT2020 outlines the effort towards the innovative doctoral training principles as a key feature for the future. The newly established international doctoral school Gran Sasso Science Institute

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<sup>63</sup> <http://statistica.miur.it/scripts/postlaurea/vpostlaurea.asp>

<sup>64</sup> As evidenced in NRP 2013 a fund of €2b is available for regions which intend to finance doctoral schools, university master and high education courses.

<sup>65</sup> Anvur released the guidelines for the evaluation of doctoral courses in December 2014. The guidelines can be downloaded at: [http://www.anvur.org/index.php?option=com\\_content&view=article&id=736:versione-finale-del-documento-anvur-sulla-valutazione-dei-corsi-di-dottorato-it&catid=67:news-dottorato-di-ricerca-it&Itemid=502&lang=it](http://www.anvur.org/index.php?option=com_content&view=article&id=736:versione-finale-del-documento-anvur-sulla-valutazione-dei-corsi-di-dottorato-it&catid=67:news-dottorato-di-ricerca-it&Itemid=502&lang=it)

<sup>66</sup> In accordance with the Anvur assessments.

(GSSI) managed by Istituto Nazionale di Fisica Nucleare – INFN (art. 31bis of Law 35/2012, funded by €12m a year for 2013-2015) can become a pole of attraction for foreign students and give them the opportunity of studying within the RI located in Gran Sasso.

### **3.2.6 HR strategy for researchers incorporating the Charter and Code**

The reform of universities has required a rewriting of the Statutes that regulate their self-government. Laws 1/2009 and 240/2010 supported the incorporation of the principles of the ‘European Charter and Code of Researchers’ introduced by the EU. They are now widespread in universities Statutes, although at the level of secondary regulation; this limits the effectiveness of the principles that have been introduced; researchers’ organisations and trade unions objected to some of the procedures outlined by the Charter. At national level there are not specific funding lines to support the Charter and Code of researchers and no evaluations are so far available.

The calculation of the performance based share of institutional funds (FFO and FOE, discussed in Chapter 2 above) does not include any score based on the effective implementation of the principles of the Charter and code. Nor any additional score is given to the universities that have obtained the ‘Human Resources Excellence in Research’ award from the EU; at the end of 2014 nine Italian HEIs had obtained such a distinction.

The labour market for researchers in Italy has a negative outlook, as shown in Chapter e and par. 3.2.2. In 2014 no new policies to increase its attractiveness especially for young researchers were introduced. As outlined in par. 3.2.2 the joint effects of the 2010 reform and the budget law are bringing the whole system towards a downsizing path.

### **3.2.7 Education and training systems**

The number of enrolments of students in universities decreased deeply in the last years<sup>67</sup> and the human capital implications for the country, especially in the case of scientific disciplines, have not been addressed yet. University education, moreover, appears to be less attractive than in other countries due to the limited demand of high skills coming from the Italian business sector, where high technology activities are lower than in the EU average. The importance of inter-disciplinary competences, ‘soft skills’ and public-private partnerships is stressed by Italy’s strategic documents (HIT 2020 and PNR 2014-2020), and are relevant issues in the new doctoral reform, but at the end of 2014 no effective measure was introduced to address such a problem.

Law 1/2007 introduced mechanisms for the promotion of excellence in the education system; MIUR manages a programme giving awards to excellent secondary students and a national register of excellent students has been created. At university level, the MIUR finances and acknowledges 12 ‘excellent’ schools and 14 ‘colleges’ (student residences), where access and permanence depends on the educational achievements of students.

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<sup>67</sup> A detailed analysis of the fall of the number of university students is available in CUN (2013).

### **3.3 ERA priority 5: Optimal circulation and access to scientific knowledge**

#### **3.3.1 e-Infrastructures and researchers electronic identity**

The national strategy of access to digital research services and electronic identity to researchers for transnational access are implemented by the GARR consortium and by IDEM federation<sup>68</sup>.

The GARR network, controlled by the MIUR, is the e-infrastructure of the scientific community in Italy. It is a consortium of universities and research institutions that provides networking and computing services to the research community. The IDEM federation is a service of the GARR network and it is the major initiative in the field of electronic identity for researchers. IDEM federation started its activities in 2009 and includes the majority of universities and research institutions in Italy

IDEM provides access to some digital research services such as scientific data, scientific journals and cloud computing resources. The IDEM approach relies on the provision of digital services to researchers with their own user account. Researchers can access to the digital services of IDEM according to the agreements and the subscriptions of their institutions.

GARR is also in charge of the management of personal data security and identity certification, cloud computing and scientific software targeted for the research community. Nonetheless a targeted national policy for these services is still missing though in 2012 the open data law (Law 221/2012) in art. 9bis sets up the guidelines for the acquisition of software (open source software too) and the development of cloud services for the public administration.

The programme of the Agency for the implementation of the Agenda Digitale (AgID) includes the whole public sector and is not specifically targeted to the research and university sectors.

#### **3.3.2 Open Access to publications and data**

The 2004 Messina Declaration has been the first step to introduce, on voluntary basis, open access in the academic system. CRUI, the conference of deans of universities, has been the pioneer for the implementation of Open Access (OA), policies in the Italian scientific community. In 2006 CRUI created a specific working group to implement the Berlin Declaration principles. The working group set up guidelines for the deposit of PhD thesis (2007), institutional repositories (2009), open access journals (2009), metadata management in open access repositories (2012) and a recommendation on open access and peer review of scientific research (2009). Currently CRUI is still active in the promotion of OA working in cooperation with CUN, the consultative body of MIUR, for promoting OA<sup>69</sup>. CRUI supported the participation of the Italian HEIs to the Berlin declaration principles, and the introduction of OA into the university statutory regulations. At the end of 2014, 71

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<sup>68</sup> GARR: <http://www.garr.it>; IDEM federation: <https://www.idem.garr.it/>

<sup>69</sup> CRUI and CUN released some joint declarations on OA. They can be downloaded from the CRUI site: [www.cruui.it](http://www.cruui.it)

universities signed the Berlin declaration<sup>70</sup> and 35 university included OA into their statutes<sup>71</sup>.

The CRUI guidelines made available specifications on the preservation of the information and on the promotion of open source software for the management of open access systems.

Only in 2013, with Law 112/2013, OA has been stated as a compulsory modality for research output when funded by the public budget for at least 50% -. Law 112/2013 indicates the gold road and the green road as OA modalities. The green road defined by Law 112/2013 is based on an embargo period (18-24 months) longer than the international recommendations.

On 2013 MIUR released a call for RI that earmarked €10m to develop systems based on open access for long term preservation of research results. In 2014 the SIR call incorporated OA as mandatory modality for the publication of the output of the awarded projects.

Pleiadi, the open access reference web site in Italy, managed by two university consortia (CINECA and CASPUR), indexes 46 institutional repositories and 14 journals<sup>72</sup>. A growing number of Italian journals and repositories are indexed by the two major international web portals: Opendoar.org indexes 84 academic Italian repositories<sup>73</sup>, in 2013 doaj.org indexes 292 Italian journals<sup>74</sup>. CRUI guidelines do not specify the standard modalities for open access policies (green or gold).

Italy participates to the major international OA initiatives (MedOANet, PEER, NECOBELAC, Recode and OpenAIRE).

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<sup>70</sup> The figure is updated at November 2014. The list of signatures is available at:

<http://openaccess.mpg.de/319790/Signatories>

<sup>71</sup> Source:

[http://wiki.openarchives.it/index.php/Statuti di ateneo: clausole sull'accesso aperto inserite nel testo](http://wiki.openarchives.it/index.php/Statuti_di_ateneo:_clausole_sull'accesso_aperto_inserite_nel_testo)

<sup>72</sup> <http://www.openarchives.it/pleiadi/progetto-pleiadi/risorse-indicizzate>

<sup>73</sup> <http://www.opendoar.org/countrylist.php?cContinent=Europe#Italy>

<sup>74</sup> [http://wiki.openarchives.it/index.php/Dati e cifre sull'Open Access in Italia - 2013](http://wiki.openarchives.it/index.php/Dati_e_cifre_sull'Open_Access_in_Italia_-_2013)

## **4. Innovation Union**

### **4.1 Framework conditions**

Italy's main policy efforts in the field of the Innovation Union have included tax credits measures for firms collaborating with universities, the doctoral reform aimed at promoting partnerships between universities and private business and legislation supporting start-up firms. The framework of these actions is a common policy view that considers the integration between R&D and innovation and business activities as a key factor of competition; public-private cooperation as an important direction for change; and the emergence of more dynamic firms in fast growing sectors as a crucial factor in the evolution of Italy's economy.

The framework for policy implementation of such actions has been provided by the joint management of many programmes - such as PONREC - by MISE and MIUR, with an effort to combine policy tools in research with public intervention affecting business performance. Regional policies, though the R&I system is focused on the central government, are increasing their relevance for innovation especially for SMEs. Strategic documents such as HIT 2020 point out the priority given to synergies between the research system and the economy. In this context, public-private partnerships and the streamlining of the rules for researchers' mobility between the public and the private sector, as seen in chapter 3, have been key concerns. Nonetheless, the scarce financing of some programmes and the delays in the release of secondary regulations that are required for their implementation have been a limiting factor for the effectiveness of R&I policies oriented toward private business. The policies examined in previous chapters and the yearly NRP discussed in Chapter 2 - providing a comprehensive view of the policy approach of the government - complete the assessment of the framework conditions for the Innovation Union.

### **4.2 Science-based entrepreneurship**

The main policy for fostering science-based entrepreneurship in Italy has been the Start-up law (Law 221/2012) passed in 2012, that has introduced a simplification of the administrative burden for innovative start-ups, the development of certified incubators, some exceptions to labour laws, measures to help innovative start-ups to access the credit market and take advantage of innovative financial instruments such as equity crowdfunding, and some facilitations to access international markets. Moreover, specific rules allow a new entrepreneurial experience in case of financial failure of a first start-up.

MISE is in charge to implement the start-up law and in 2014 it has released all the secondary regulations to make the measures included in the law operational. The committee for the monitoring and the assessment for the start-up system will propose amendments and correct policy implementation in accordance to evidence based assessments<sup>75</sup>. In 2015 a first impact assessment will be available in the annual report to the Parliament on the monitoring of start-ups MISE (2014). The increase in number of innovative start-ups (2,755 in October 2014) and of the 19 certified incubators are encouraging signs of the success of the policy.

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<sup>75</sup> The 'Comitato tecnico per il monitoraggio e la valutazione delle politiche a favore dell'ecosistema delle start up innovative' is managed by MISE and includes members from the Chambers of Commerce, the National Statistical Institute, the stock exchange regulator and external independent experts.

### **4.3 Knowledge markets**

Knowledge markets have a limited extent in Italy, considering the characteristics of the country's R&I system. Still, government policy has made efforts to strengthen the IPR system and encourage the use by firms of IP tools. The last reform of IPRs has been introduced in 2010 (DL n. 131, 13 August 2010); it has promoted creativity and invention by researchers and universities and streamlined the access to patenting procedures. Since 2011 MISE, the ministry in charge of IPRs, provided support to national initiatives such as prize competitions for patenting firms and benefits for firms bringing innovations to market. Since 2012 IPRs were associated to the start-up framework. The 2013 initiatives for start-ups included also patenting and IPR issues<sup>76</sup>. The 2015 stability law introduced some optional tax holidays for patents and trademarks trading. The new taxation regime of patents and trademarks reduce of 50% the income taxation in case of 90% reinvestments within the firm.

Developments in knowledge markets in the last two years have included different initiatives. In 2014 Unioncamere, the Union of Italian Chambers of Commerce, CNR and COTEC developed an online patent database to encourage the use by firms of the patents held by Italy's public research organisations. Since 2013 a funding facility within the Fondo Nazionale per l'Innovazione (FNI) is available for innovative projects based on patents. The financial fund IPGEST plans to invest €40.9m in SMEs active on patents.

Since 2011 government policies have encouraged patenting - and the use of other IPRs - by Italian firms, in particular SMEs. Initiatives include the programme 'Brevetplus' managed by MISE through the agency Invitalia. The line 'Award for patenting' is aimed to stimulate patent applications to the national and international patent offices. The line 'Incentives for the economic exploitation of patents' has the main purpose to increase the economic value of the patents of Italian firms. The programme is financed by MISE for a total amount of €30.5m. (OECD, 2014).

### **4.4 Knowledge transfer and open innovation**

Knowledge transfer is a critical issue in R&I and has often been considered as a weak link in Italy's system. The limitation to knowledge transfer arises from the traditional separation between the private and the public sector, from the structure of Italian business concentrated in low and medium technological activities and from the high number of micro-enterprises and SMEs – as pointed out by several studies including the previous ERAWATCH report (Nascia and Pianta 2014) and the Bank of Italy study (Montanaro and Torrini 2013).

Since 2010 the policy approach has focused on strengthening cooperation between public institutions and private business. Both the 2011-2013 PNR and the draft of the 2014-2020 PNR, as well as HIT2020, identified knowledge transfer as a crucial issue.

As stressed in HIT2020 the current approach relies on three layers: increasing public and private cooperation; facilitating mobility of researchers between the private and the public sector, and developing specific measures for SMEs. In 2012, the launch of the Smart Cities and the Technological Clusters calls represented an effective effort to trigger up knowledge transfer from academic institutions to private business and to advance social

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<sup>76</sup> See the MISE report to the Parliament for a list of the startup initiatives.

innovation. The Technological Clusters projects are aggregations of cooperating private and public bodies for fostering innovation in some thematic fields.

Since 2012, new legislative tools were introduced in order to favour the mobility of researchers and innovators between public and private institutions, eliminating barriers between HEIs and PROs, private business and researchers involved in international projects. In 2012 and 2013 MIUR released the secondary regulations requested by the law, namely the guidelines for managing partnerships between PROs and HEIs and private firms in order to promote the mobility of researchers. However, limited success has been obtained so far on this front.

Voluntary initiatives for the improvement of knowledge transfer between individual private and public institutions have also emerged. In 2011, an agreement between Confindustria and CRUI, the Conference of Italian University Rectors, promoted cooperation on eight measurable actions regarding knowledge transfer and researchers mobility. In February 2013, an agreement between the National Research Council (CNR) and Confindustria, the main Italian entrepreneurial organisation, promoted researchers mobility between CNR and firms and knowledge transfer.

#### ***4.5 Innovation framework for SMEs***

The major measure for innovation in SMEs is the start-up law discussed above. Additional initiatives have included the Technological Cluster programme of MIUR that supports with €266m eight aggregations of cooperating private and public bodies that foster innovation in selected thematic fields. In addition, the 2014 budget law allocated €100m for SME to provide them collateral as loan guarantees in 2014 and €50m in 2015, managed in the frame of the FCS fund, using European Investment Bank financing. National agencies have not developed any relevant partnership with the EU focusing on SMEs.

#### ***4.6 Venture capital markets***

Venture capital is not widespread in Italy. According to the association of venture capitalists, AIFI<sup>77</sup>, in 2013 in Italy only 108 firms had been financed at early stage by venture capital for an amount of €81m. Also other modalities of venture capital are less relevant than in other countries. According to the Italian Business Angels Network, only €34m had been invested in the Italian market in 2012. In order to favour new investments, the start-up law has included new measures on the financing of innovative start-ups, including tax holidays for the venture capitalists who invest, with the aim to stimulate the expansion of the venture capital market. New forms of financing - tailored for innovative SMEs - are also introduced, such as crowd-funding, 'work for equity' for external suppliers and stock options for SME personnel, as well as streamlined access to some benefits regarding collaterals for bank credits.

Attention has also been devoted to the attraction of foreign investment. As stressed by the OECD, since 2013 the government strategic document 'Destinazione Italia'<sup>78</sup> has developed

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<sup>77</sup> (AIFI, 2014) The AIFI report "Il mercato italiano del private equity e venture capital nel 2013" can be downloaded from <http://www.aifi.it/?wpdmact=process&did=MjcwLmhvdGxpbms=>.

<sup>78</sup> (PCM, 2013) The English version of the government strategy "Destinazione Italia" can be downloaded from <http://destinazioneitalia.gov.it/wp-content/uploads/2013/10/destinazioneitaliaEnglishVersion.pdf>

a national policy to attract foreign investments and improve competitiveness focusing on innovation and the connection between research and the production system (OECD, 2014).

#### ***4.7 Innovative public procurement***

The major recent development in public procurement has been the digitalisation of public tenders. CONSIP is the agency in charge of the implementation of e-procurement. Since 2013 the Mercato Elettronico della Pubblica Amministrazione (MEPA), has become operational, with a platform based on a register of suppliers (80% of them are SMEs), which can offer goods and services to the public administration. In turn, the public administration may define specific procedures, select the least expensive offers and include, if requested by the tender, specific features, such as calls for goods based on recycled materials or with a low environmental impact.. The adoption of the CONSIP<sup>79</sup> system or the participation to the MEPA platform is increasingly required for local and central government institutions, especially for tenders above EU thresholds (Law 89/2014).

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<sup>79</sup> The tender database of CONSIP is focused on programmes and conventions for large contracts. MEPA is focused on smaller contracts, below the threshold of EU tenders.



## **5. Performance of the National Research and Innovation System**

### ***5.1 Performance of the National Research and Innovation system***

A few key indicators of the performance of Italy's research and innovation system are discussed in this section, complementing the evidence provided on activities and funds in the previous chapters; the performance in terms of funds and R&D resources has been presented in section 2.2 above. The focus here will be on the scientific output of research and on innovation performance.

#### **The high output of Italian research**

A growing body of evidence is now available on the quantity and quality of the output of Italian scientific research. The ERAWATCH Country Report 2013 (Nascia and Pianta 2014) already reviewed the first ANVUR report on the Evaluation of research quality for the period 2004-2010 (ANVUR, 2013) focusing on Universities and Departments and using peer-review processes, lists of scientific journals for ranking research quality and other assessment tools. ANVUR showed that the growth of the share of Italian publications is one of the fastest in Europe, above the EU average, and a strong performance is also found for cooperation with foreign institutions. In the same years the Italian share of top publications (those receiving the top ten citations in each field) is also above the world average. Italy's output productivity for both universities and Public research organisations is among the top countries. In terms of scientific specialisation, Italy expanded its efforts in Industrial Engineering, Mathematics and Computer science, Agriculture and Earth sciences, and recorded lower shares in Physics, Chemistry, Health and Biology.

The ERAWATCH Country Report 2013 on Italy also summarised the results of the International Comparative Performance of the UK Research Base, based on the Scopus database carried out by SciVal Elsevier. That study ranks Italy at the top in terms of the productivity of university research, measured by the number of articles per million of euros spent for R&D and by the citations obtained per million of euros spent for R&D; in these indicators Italy is at the same level as top performing countries such as the UK and Canada (SciVal-Elsevier 2013).

In 2014 two main new studies have appeared on the output of Italian research. The first one is the ANVUR report on universities and research (ANVUR 2014) that provides evidence based on the ISI Web of Science database of Thomson-Reuters and on the SciVal Scopus database of Elsevier. Data show that Italy's share of world scientific publication is now 4.4% in the fields of 'hard sciences' (including health and engineering, defined by ANVUR as 'bibliometric fields' where quantitative data are more reliable and relevant) and 1.9% in social sciences and humanities, with an increasing trend in both cases. Italy appears to be specialised in Mathematics and physics, Earth sciences, Health sciences in the former group, and in Decision sciences, Economics and finance and psychology in the latter (ibid., p.485-490). In social sciences and humanities the English language bias of available databases and the greater importance of publications in national languages explain the lower share of Italian scientific output. However, even in this area the citations of Italian articles are below those of the UK but similar to those of Germany and higher than French

and Spanish ones. Considering 'high quality' articles in 'hard sciences' – those included in the top 10% of the most cited world articles published in 2008 and receiving citations in the 5 following years – Italy's share is 13.1% of all its publications, as opposed to 13.4% of France, 15.5% of Germany, 16.6% of the UK (ibid., p.498).

The ANVUR report also assesses the productivity of Italian researchers by relating scientific output to the expenditure for R&D. Considering the SciVal-Scopus database for 2010, Italy shows 3.88 publications per million R&D expenditure (in US dollars at 2005 prices), as opposed to 2.33 in France, 1.78 in Germany, 4.14 in the UK. When only public R&D is considered, the values are 9.15 for Italy, 6.55 for France, 5.42 for Germany and 11.31 for the UK. The latter indicator has increased substantially over the previous 5 years for Italy, while it has declined for Germany and remained stable for the other countries. It is remarkable that in a context of drastic reduction of public resources the productivity of Italian researchers continues to improve and results 40% higher than German productivity (ibid., p.516). Even more striking results are obtained when productivity is measured in relation to the number of researchers: in 2010 Italy produced 0.54 articles per researcher as opposed to 0.31 in France, 0.27 in Germany and 0.38 in the UK. When public researchers only are considered, the productivity indicator is 0.82 for Italy, 0.73 in France, 0.47 in Germany, 0.51 in the UK. Again, Italy is the only country to record a steady improvement of such data over time; the productivity growth of the shrinking pool of Italian researchers and the lead over major EU countries is indeed remarkable (ibid. p.518).

A second study on Italy's research output has been carried out by the Bank of Italy (Montanaro and Torrini 2013); after a wide ranging survey of available databases on scientific publications – including SCImago, Science Watch, and the French OST – it concludes that in terms of quantity of publications by public and private researchers Italy ranks fourth among EU countries after the UK, Germany and France, with about 3.4% of all scientific publications and citations; outside Europe, the US, China and Japan have a larger scientific output than Italy (ibid., p.27, table A13). If scientific publications are divided by the number of researchers Italy emerges as the leading country. Montanaro and Torrini (2013, p.29, fig. 10) show that, using SCImago and OECD data for 2010, Italy has 726 articles per one thousand researchers, against 550 in the UK and about 400 in France and Germany. Remarkably, the number of citations received (excluding self-citations) per researcher (in full time equivalent units) is close to 2, by far the highest value and almost twice the citations received by researchers from France and Germany (ibid.).

The study also reports SCImago data for the main universities and research institutes. First, the comparison is carried out among universities that in 2006-2010 published at least 1,500 articles. In Italy 49 universities were considered, whose researchers authored 326,000 articles; the average – 6,700 publications per university – was greater than in Japan, France (5,000) and Spain and lower than in the US, UK and Germany (7,600). The same ranking emerged in the 'high quality' publications that appeared in the top quartile journals of their field as ranked by SCImago – 3,700 per university in Italy; 2,900 in France; 4,200 in Germany (ibid. table A18, p.57). Second, the analysis was carried out on major research organisations; in the period 2003-2010 Italy's National Research Council produced 63,000 publications, 64.2% of which appeared in the top quartile journals of their field as ranked by SCImago. This share was higher than the one of the French CNRS

(58.8%) and lower than that of the German Max Planck Gesellschaft (70.7%) and of the Spanish CSIC (68.1%) (ibid. table A21, p.61).<sup>80</sup>

### **Italy's weak innovation performance**

The Innovation Union Scoreboard 2014 (European Commission 2014) provides a ranking of the overall performance of EU member's states, based on an index built from the joint analysis of 24 indicators. As in previous years, Italy falls into the group of "moderate innovators" including Southern and Eastern European countries only, with a performance below the EU-28 average. Out of the 8 dimensions considered in the calculation of this synthetic indicator, Italy performs badly in human resources due to low skills of its workforce and in the availability of financing innovation; it is closer to EU-28 average in innovation performance, economic effects, intellectual assets and patents. The evolution over time of this indicator shows a steady improvement of Italy's index, moving closer to the EU-28 average from 2006 to 2012, with a moderate worsening of its relative position in 2013 (ibid., p.21). Looking at the individual components of the index, Italy lags behind in "Non-EU doctorate students" and "Innovative SMEs collaboration activities", while relative strengths are in "International scientific co-publications" and "Community designs". Italy's indicators have improved in the case of "Non-EU Ph.D. students", "License and patent revenues from abroad", and in its fields of strength that are international scientific co-publications and community designs. Conversely, Italy is losing ground in "Venture capital investments", "Non-R&D innovation expenditures" and "Employment in knowledge intensive activities" (ibid., p.54).

More detailed evidence on the innovation performance of Italian firms in the EU context is provided by the results of the new Community Innovation Survey 2010-2012 (ISTAT 2014b). In the three years considered 51.9% of firms (with 10 employees or more) have carried out innovative activities but only 33.5% have actually introduced at least a product or process innovation; the share is 43% in industry and 28% in services. Even among the largest firms with more than 250 employees this share has been limited to 66.7% of firms (ibid., p.1). The total expenditure for innovation in 2012 has been €24bn – half of which in R&D, one third in new machinery. This means, on average, €6,300 per employee, a value that again is higher in industry (€8,300) than in services (€4,200), but that is surprisingly lower in larger firms (€6,000) than in enterprises below 50 employees (€6,500). Compared to 2010, firms' efforts have declined substantially, as in 2010 average expenditure amounted to €7,700 per employee (ibid., p.4).

The main indicator of the economic relevance of innovations is the share of firms' sales due to new products; in 2012 this share was 7.6% for products new for the market and 8.7% for products new for the firms alone (and already produced by market competitors). These are extremely low values, lower than in previous surveys, documenting the limited relevance of innovation in Italian firms. Moreover, the aim of the introduction of innovation is cost reduction in almost 60% of firms, followed by a search for greater flexibility in one

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<sup>80</sup> An additional study of the Bank of Italy tried to rank Italian universities on the basis of individual data on graduates' employment and earnings, considered as indicators of the 'quality' of tertiary education. The investigation accounts for field of specialization and local labour markets, but acknowledges the shortcomings of the model used in reflecting the contribution of each university to the 'employability' of their graduates (Ciani and Mariani 2014).

third of cases. Conversely, the search for new products is relevant for less than 30% of firms, and efforts to create new markets are reported by a slightly lower share of firms. Therefore the direction that innovation is taking is a strategy of cost-based competitiveness much more than the creation of new technology based competitive advantages (ibid. p.8).

The main obstacles identified by firms in their efforts to introduce innovations include a strong price-based competition (in more than half of respondents), lack of demand (in 40% of firms), administrative burden (40% of firms), while only a quarter of firms declare that the lack of financial resources is a main problem (this used to be the main obstacle to innovation in the past) (ibid., p.9). Finally, the role of public support to innovation is limited, with 20.7% of firms introducing innovations stating that they have received some form of public support (the share is 35.8% for larger firms), mainly from regions and local authorities. Only 5.9% of innovating firms (20.9% for larger firms) has obtained national incentives and just 3.2% (10.5% for larger firms) has had support from the EU (ibid. p.6).

The overall picture that emerges from the latest innovation survey for Italy's economy is bleak. The effects of the depression are evident, with less innovations and the lack of demand emerging for the first time as one of the most important obstacles to innovation. If we compare the results for 2010-2012 with the previous survey on 2008-2010 (ISTAT, 2012) we find a stability in the overall introduction of innovations (31.5% in 2008-2010, 33.5% in 2010-2012) but an increase of the firms which only introduce new processes (from 25% to 27%). There is a serious fall in innovation expenditure (€28bn in 2010, €24bn in 2012), much lower innovation-related sales (25% in 2010, 16.3% in 2012), a radical change of direction of innovation efforts away from new products – in 2010 more than 80% of firms had the aim of improving the quality and extending the range of products, objectives that in 2012 are irrelevant – and, finally, a major fall in the share of firms receiving public support for innovation (30%, as opposed to the current 21%) (ibid, pp.1-8).

Some of these results reflect the short term impact of the economic crisis; the lack of demand – for instance – is holding back innovation efforts and the launch of new products. However, the six years of depression of the Italian economy are now having long term effects on the country's economic and innovation base. Industrial production in 2013 was just 79% of its pre-crisis 2008 level in Italy as opposed to 98% in Germany; only Spain and Greece had lower values than Italy (Pianta, 2014, p.282). The loss of such a large share of industrial activity has hit high technology firms and has intensified price-based competition, with the consequence of weakening the R&I system and orienting innovative efforts towards cost reductions (including cuts in employment), away from the search for new products and markets that offer a stronger base for the technology-based competitiveness of European countries.

Austerity policies have reduced the public resources available for supporting research and innovation in firms, while government action had to focus on the immediate problems of firm closure and job losses, rather than fostering the longer term perspective of knowledge-based growth for the country. In parallel, private investment – in R&D as well as in innovation-related new machinery – have fallen contributing to a 'vicious circle' of falling demand, lower production and lack of investment that is further depressing demand.

The consequences for Italy's R&I system could be very serious, including a permanent loss of a significant part of its production capacity; a greater presence of foreign firms

transferring abroad R&D, innovation and managerial activities; a brain drain also in the business sector, with highly skilled personnel searching for new jobs abroad; a further weakening of the coherence of the R&I system. It is unfortunate that such emergencies of Italy's R&I system have not yet become the object of new government policies.

A complementary evidence on innovation in Italian firms has emerged from the latest MET report<sup>81</sup> (Brancati, 2015, forth.) that is based on a survey on a representative sample of 25,000 firms of all size (including those with 1-9 employees); the questionnaire is similar to the one used by the Community Innovation Survey. The results for 2013 show that 18.2% of firms have introduced a new product or a new process in the three previous years, up from the 11.7% of 2011; this value, however, is still half the pre-crisis level of 35.6% in 2008. The lower value than the one reported by ISTAT in the Community Innovation Survey is due to the inclusion in the MET survey of micro-firms that have much lower innovative activities. The MET report, conversely, finds an increase of the share of firms undertaking R&D, which appears to have returned to 2008 levels in all size classes. R&D efforts are much more frequent in firms with international activities, and the MET report suggests that the dynamic part of Italian firms has reacted to the crisis with an increase of international production and search for foreign markets, that may have 'pulled' new R&D efforts. The MET report also documents a strong increase in the number of firms which could not undertake investments due to lack of credit from banks (17.4% in 2013 against 8.7% in 2011). In parallel, the relevance of public support to firms has continued to decrease; the MET measure of industrial policy gross funding to firms estimates a value of about €2bn in 2013, against almost €3bn in 2009 and €6bn in 2002 (Brancati, 2015, forth.).

Additional evidence on the weak innovative performance of Italian firms comes from patent statistics. From Italy approximately 44,000 patent applications were made at the European Patent Office (EPO) in the period 2000-2010, against 177,000 from Germany and 66,000 from France. In the same period, Italy's National Patent Office received over 44,000 applications, against 234,000 in Germany and 81,000 in France. The structural weakness of Italy's innovative activities is again confirmed.

On average in 2012, Italy produced 13.09 publications per 10,000 inhabitants, above the EU-28 average (13.8). They are also internationally orientated with 41.32% of publications internationally co-published. In 2012, Italy had about 575 international scientific co-publications per million population, lower than other big countries such as UK (1070), Germany (784) and France (768). In the period 2002-2012, 11.6% of the Italian scientific publications were in the top 10% most cited publications worldwide in comparison with 11% of top scientific publications produced in the EU28 (Science Metrix, 2014)<sup>82</sup>. The share of public-private co-publications in Italy is 1.8% in the period 2008-2013 against 2.8% for the EU28<sup>83</sup>.

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<sup>81</sup> MET, Monitoraggio Economia Territorio, is a private research institution which publishes on yearly basis a report on the Italian firms based on a field survey. (<http://www.met-economia.it/>).

<sup>82</sup> These publication data are based on Elsevier's Scopus database. ScienceMetrix, Analysis and Regular Update of Bibliometric Indicators, study conducted for DG RTD. They represent an update of the data displayed in the table below. See also [http://ec.europa.eu/research/innovation-union/index\\_en.cfm?pg=other-studies](http://ec.europa.eu/research/innovation-union/index_en.cfm?pg=other-studies).

<sup>83</sup> Scival 2014, Scopus based publication indicators derived from Elsevier's SciVal platform, [www.scival.com](http://www.scival.com), last accessed December 2014.

**Table 2. Assessment of the Performance of the National Research and Innovation System**

<b>1. ENABLERS</b>	Year	IT	EU
<b>Human resources</b>			
New doctorate graduates (ISCED 6) per 1000 population aged 25-34	2011	1.50	1.70
Percentage population aged 30-34 having completed tertiary education	2012	21.70	35.80
<b>Open, excellent and attractive research systems</b>			
International scientific co-publications per million population	2012	532.40	343.15
Scientific publications among the top 10% most cited publications worldwide as % of total scientific publications of the country	2009	10.37	10.95
<b>Finance and support</b>			
R&D expenditure in the public sector as % of GDP	2012	0.53	0.75
Venture capital (early stage, expansion and replacement) as % of GDP	2012	0.02	0.08
<b>2. FIRM ACTIVITIES</b>			
R&D expenditure in the business sector as % of GDP	2012	0.69	1.31
<b>Linkages and entrepreneurship</b>			
Public-private co-publications per million population	2011	33.41	52.84
<b>Intellectual assets</b>			
PCT patent applications per billion GDP (in PPS€)	2010	2.09	3.92
PCT patent applications in societal challenges per billion GDP (in PPS€) (climate change mitigation; health)	2010	0.48	0.85
<b>3. OUTPUTS</b>			
<b>Economic effects</b>			
Contribution of medium and high-tech product exports to trade balance	2012	N/A	1.27
Knowledge-intensive services exports as % total service exports	2011	27.53	45.26
License and patent revenues from abroad as % of GDP	2012	0.20	0.59

Source: European Commission, IUS Database (2014).

## ***5.2 Structural challenges of the national R&I system***

On the basis of the information emerging from the previous chapters and from the section above, the Italian R&I system is characterised by five main structural challenges – some of them already pointed out in the ERAWATCH Country Report 2013 (Nascia and Pianta 2014):

- The downsizing of higher education;
- The weak formation of human capital and the brain drain of researchers;
- The weak R&D and innovation activities of firms;
- The size distribution of firms;
- Growing territorial inequalities.

### **The downsizing of higher education**

Italy's higher education system has long been characterized by lower financial and human resources, in comparison with other European countries. According to the OECD in 2011 the

annual expenditure per student by tertiary education institutions was \$9,990 as opposed to the OECD average of \$13,958. The Public support for education to private entities as a percentage of GDP is lower than the OECD average, and Italy's expenditure on university education in 2011 was 1% of GDP, thirty per cent less than the OECD average (1.6%).

The budget reductions associated to austerity policies have made these problems more serious, widening the gap with European standards. Chapter 2 – and the reports by CUN (2013) and ANVUR (2014) – have already documented the extent of the reduction in funding, staff and students. The expected fall in the number of permanent and temporary staff of universities due to retirement trends, and the lack of new employment opportunities for young researchers might lead to extremely dangerous developments, which require urgent policy action. In fact, the current outlook for Italy's higher education system is a continuous downsizing that would make universities unable to perform their institutional role in higher education and research. It is a paradox that such a downsizing of Italian universities takes place when the evidence on the productivity of research puts Italy at the top of international rankings, as shown in section 5.1. Italy's R&I policy has recently emphasised the need to provide funds on the basis of the evaluation of performances. The good international performance of Italian researchers would deserve – at least – a level of funding closer to the EU average.

### **The weak formation of human capital and the brain drain of researchers**

Human capital in Italy is in danger. Whether we consider educational levels among the population, the relevance of high skills, or the number of researchers working in the country, we find a weakening of Italy's position and growing gap with European standards.

First, the low share of citizens holding a higher education degree has long been an Italian problem; IUS 2014 data show that in 2012 the share of population aged 30-34 with tertiary education attainment was 21.7%, well below the EU-28 average of 35.8%. Conversely, the proportion of people aged 20-24 having completed upper secondary education was 77.6%, not far from the EU average of 80.2%. The number of first-time graduates – excluding those from Master courses ('Lauree magistrali') – was 160,000 in 2000, 290,000 in 2005 and fell back to 210,000 in 2011-12 (ANVUR, 2014, p.17). The total number of university students in all courses was 1,674,000 in 1999-2000, before the reform of university courses, reached a maximum of 1,824,000 in 2005-2006 and has then declined to 1,751,000 in 2011-2012 (ibid., p.41). These trends are the result of several factors. The downsizing of universities pointed out above has reduced opportunities for higher education; a steep rise in university fees (75% in the period 2009-2014), now in line with OECD average (ibid., p.195, OECD 2013) – has made education more difficult for low income students; 19% only of Italian university students receives scholarships – against a OECD average of 50%; the weak returns of investments in education – including low employment prospects and the low wage differential with workers with secondary education – may discourage the pursuit of a university degree (see ANVUR 2014 and chapter 3 above).

Second, Italy's gap in high skills and in the number of researchers is widening when such human resources are crucial to sustain economic and social development and increase the country's competitiveness. In chapter 2 we showed that, according to ISTAT, in 2013 about 19,000 Italian graduates migrated abroad, 30% of total migration outflows; in 2011 they were about 10,000. While no comprehensive data on the 'brain drain' of researchers is

available, fragmentary evidence from a previous ISTAT's survey on PhDs (ISTAT, 2011) and OECD data on transfers of authors of scientific articles from Italian to foreign institutions suggests that several thousand Italian researchers are now working abroad (out of just 50,000 permanent staff in Italy's universities). This represents a serious loss for Italy's R&I system, a threat to its sustainability in terms of scientific research and teaching, and a major drawback for the possibility to catch up in innovation and economic performance with the rest of Europe.

### **The weak R&D and innovation activities of firms**

The evidence of section 5.1 – based on innovation surveys and patent data – has documented the extent of the weakness of the innovative efforts and performances of Italian firms. This has roots in the loss of Italy's high technology industries, in the evolution of its pattern of specialisation and in the small firm size (see below). As already pointed out in the ERAWATCH Country Report 2013 (Nascia and Pianta, 2014) Italy is going through a de-specialisation in high-tech sectors, with the exception of industrial machinery and, in part, of the chemical industry, while "traditional" industries dominate current production and trade specialisation. S&T activities show a significant scientific specialisation (based on publications) in pharmaceuticals and a high concentration of patents in the field of 'other machinery and electrical equipment'. Such characteristics of Italy's economy are associated to low R&D expenditure by firms and low innovation efforts. These long standing problems have been worsened by firms' strategies that have searched for competitive advantages through lower costs (mainly of labour) rather than through innovation, and by the effects of the long economic crisis, that brought a lack of domestic and international demand and a fall of more than 20% in industry output compared to pre-crisis 2008 levels, as documented in chapter 2.

In this context, the preservation of existing industry and the support for the emergence of new firms in activities characterized by higher R&D, innovation, learning processes, in fields with strong demand and environmentally sustainable products and processes appear as policy priorities, in line with the Europe-2020 targets.

### **The size distribution of firms**

Micro-enterprises and family ownership are long standing characteristics of Italy's economy that set it aside from European standards of industrial organisation, which has, at least for big countries, a lower share of family owned business and has a larger mean firm size. According to ISTAT, in Italy there are only 3,495 firms with more than 250 employees, while 4.1 million firms have 1 to 9 employees. The small firm size, the lack of an ownership structure that is capable to inject fresh capital in firms, the financing constraints from the banking system, the low levels of education of Italian entrepreneurs are all factors that have prevented a change in Italy's pattern of specialisation and a move towards greater R&D and innovation activities.<sup>84</sup>

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<sup>84</sup> Also the study of the Bank of Italy argues that for R&D "in the private sector, the distance from the European average is important, largely due to the strong presence in Italian industry of small and medium firms which tend to invest less in R&D" (Montanaro and Torrini, 2013, p.38).



Again, the effects of the depression have been particularly heavy on the more vulnerable small businesses and there is a risk of loss of a significant part of the country's productive capacity. Action on this issue would require a combination of R&I and industrial policies that favour investment in R&D and innovation, alongside measures to improve access to finance to address undercapitalization problems; moves towards business consolidation in larger firms with a more managerial organisation; entry in high learning, fast growing, higher technology activities.

### **Growing territorial inequalities**

The traditional socio-economic inequality between Northern and Southern regions has not been solved in decades and – with the current depression – has shown signs of worsening. Since the nineties, EU structural funds have been the major tool for addressing territorial inequalities, and now focused on the four regions of the south – Sicily, Calabria, Puglia and Campania – eligible for EU Convergence Objective 1 policies, as discussed in chapter 2. The R&I system reflects the same divide of the economy as a whole. R&D is concentrated in four major Northern regions – Lombardy, Piedmont, Emilia-Romagna and Veneto – and in Lazio, the region around Rome. The location of the new start-ups also shows a concentration in Northern regions. Similar divides concern university funding, tertiary education and university students, innovation and firm performances. All the problems identified above – the downsizing of higher education, the worsening of human capital, the weak innovation – have a territorial dimension that makes problems worse in Southern regions and peripheral areas. As gaps in R&I activities between Italy and European averages grow, the deepening of territorial inequalities becomes an additional emergency for Italian research and innovation system.

### ***5.3 Meeting structural challenges***

The structural problems summarized in the previous section from the evidence provided in this report indicate multiple dimensions of the policy challenges that Italy is facing in adjusting R&I policies to the present context. Current trends – made worse by the long economic crisis – are leading to a structural downsizing of the country's university and research system and of firms' innovative capacities, with widening gaps within Europe and Italy itself. If policy changes are not introduced, major consequences may follow. Parts of the R&I system may become unable to operate effectively and to cooperate at the European level. A permanent loss of scientific competences and human capital may take place through the 'brain drain' and the scaling down of participation to higher education. A permanent loss of production and innovation capacity may take place through the closing down or outsourcing of production, the foreign acquisition of Italian firms, the deepening of Italian specialisation in low R&D, low-tech, low skill, and low innovation activities. The distance from Europe in all these fields would increase dangerously, and the possibility to integrate Italy's activities in the European context and in EU policy priorities would be at risk. Five cross cutting policy changes – outlined below – may be needed to avoid such risk.

### **The resource problem**

There is no way to reverse the downsizing of higher education and the weak formation of human capital without a drastic increase of the public and private resources devoted to

R&I activities. An immediate return to the 2008 levels of funding and the number of research personnel is a necessary first step for reversing the widening gaps that have been documented in this report. In the medium term, bridging the gap with EU averages in most funding indicators is urgent.

Policy tools to this end are different for public and for private resources. In the case of public funds for R&I, such a large increase of resources may come either from national or from European funds.

If the additional funding has to come from Italy's public budget, maintaining the current austerity policy framework, a drastic reorientation of budgetary priorities towards R&I would be needed; an alternative solution would be for Europe to leave national public expenditure for R&I – and public investment – outside the fiscal constraints of the Stability and Growth Pact and the Fiscal Compact.

In the case of private funds for R&I, policy is likely to be less effective, considering the past behaviour of Italian firms that have long devoted little efforts to R&I and during the crisis have cut back all sorts of investment. Though some policies measures are showing some positive signs, as for the case of the start-ups they have not reached the size to turn the current trend as witnessed by the official figures on R&D investments.

### **A new public-private balance**

The weaknesses of Italy's R&I system are – to some extent – the evidence of the failure of policies that have downsized public activities in the hope that private initiatives could take the lead in R&D, innovation and investment. This was the view that in the 1990s had led to the privatization of almost all large public enterprises, such as TelecomItalia (communications) and ENEL (energy), which were then active in a wide range of high technology sectors with large R&D activities. Twenty years later, we can see that private initiative has largely given up this challenge and Italy has lost a large part of business R&D and production activities in most of those fields – including electronics, telecommunications, railways equipment, aerospace, pharmaceuticals, chemicals, steel, energy, etc. At the same time, Italy's private firms have been largely unable to enter in a significant way new fast growing activities that have since emerged – including software, internet-based activities, biotechnology, photovoltaic cells, etc.

In the same way, little progress has been recorded in private activities for scientific research and private higher education. It seems that the time has come to acknowledge that a new balance between public and private activities has to be restored, with new types of public policies and institutions identifying long term national priorities and guiding private initiatives in high risk emerging fields. This is also the message of the study by Mariana Mazzucato (2013) on science and innovation policies in the US and Europe, showing that the success of US electronics and internet companies – such as Apple and Google – relies on the exploitation of results of massive public investment for R&D, on 'patient capital' and on large public procurement contracts, rather than on the 'vision' and 'entrepreneurship' of private investors and venture capitalists.

In Italy, a first step would be the reconstruction of a capable and competent public sector – less concerned with short term private-style 'efficiency' and 'competition', and more concerned with the long term priorities of the country's economic, social and environmental future. The high performance of Italy's universities and PROs – highlighted in section 5.1 –

in spite of the drastic cuts they have suffered, is a positive sign of the potential dynamic role that institutions, researchers and managers acting in the public interest could have.

### **Reconstructing the conditions for innovation in the economy**

The weakening of Italy's economy as a result of the crisis and the major gaps in business R&I compared to Europe are perhaps the most serious policy challenge. The small number of large firms that could play a leading role in R&D and innovation in emerging fields, the weakened business networks among SMEs and the lack of commitment by the banking system towards R&I are all factors that suggest that very few relevant private actors are available for reconstructing the conditions for innovation in the economy.

A new industrial policy is probably needed with a new role for public intervention in shaping and funding on a large scale not only basic R&D in private firms, but also new 'strategic' investment in ICT applications, environmental sustainability, health and welfare systems, including new business ventures in high risk activities.

### **Convergence in R&I**

R&I divides across regions within Italy should become a source of major concern. The growing divergence in education, employment opportunities, skills and competences, research capacities leads to deep, fundamental imbalances in Italy's economy and society. It may lead to a 'vicious circles' of production decline, high unemployment, 'brain drain' and economic depression that may change the landscape of many Italian regions. Restoring a convergence process in all these factors – starting with R&I efforts – is an essential requirement for avoiding economic, social and political disintegration.

Such concerns should attract more attention in policy making processes at all levels and should guide also the perspectives for the reconstruction of the conditions for innovation mentioned above.

### **Italy in the EU policy context**

Some Europe 2020 targets clearly maintain their relevance – such as the one about higher education level attainment – while others – in particular the one-sided emphasis on R&D to GDP ratio – appear increasingly inadequate to the specific economic and research characteristics of countries such as Italy as well as unrealistic in the context of austerity policies cutting public budgets. Nonetheless, the R&D to GDP ratio is still the most relevant target for policies and strategies.

The funding potential from EU competitive R&D projects such as H2020 appears to be misplaced when the very basis of the research infrastructure in Italy is deeply underfinanced; the number of Italian players that may compete in such projects is reduced to a handful of major universities and PROs.

Finally, the reliance on Structural Funds as a tool to support convergence processes within Europe and efforts to use them – at least to a limited extent – to support R&I have been important in Italy. A rethinking may be needed of current policies at the national and EU level – building on the arguments developed above.

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## Annex 2 – Abbreviations

AgID	Digital Italy Agency (Agenzia Digitale Italiana)
ANVUR	National Agency for the Evaluation of Research (Agenzia Nazionale per la Valutazione della Ricerca)
ASI	Italian Space Agency (Agenzia Spaziale Italiana)
ASN	National Scientific Qualification (Abilitazione Scientifica Nazionale)
BERD	Business Expenditures for Research and Development
CINECA	Inter University Consortium for Computational Applications
CIPE	Inter-Ministerial Committee for Economic Planning (Comitato Interministeriale per la Programmazione Economica)
CIS	Community innovation survey
CNR	National Research Council (Consiglio Nazionale delle Ricerche)
COST	European Cooperation In Science And Technology
CRUI	Conference Of Italian University Rectors (Conferenza Rettori delle Università Italiane)
CUN	National University Council (Consiglio Universitario Nazionale)
DDL	Law Proposal (Disegno di Legge)
D.lgs	Legislative Decree (Decreto Legislativo)
D.M	Ministry Decree (Decreto Ministeriale)
DG-RTD	Directorate-General for Research And Innovation
DEF	Document of Economic and Financial Policy
DPS	Department for development and social cohesion (Dipartimento per lo Sviluppo e la Coesione economica)
EC	European Commission
EIS	European Innovation Scoreboard
EPO	European Patent Office
ERA	European Research Area
ERANET	European Research Area Network
ERC	European Research Council
ESA	European Space Agency
EU	European Union
EU27	European Union Including 27 Member States
EU28	European Union Including 28 Member States
FAR	Fund for Applied Research (Fondo per la ricerca applicata)
FCS	Sustainable Growth Fund (Fondo crescita sostenibile)
FDI	Foreign Direct Investments
FFO	Ordinary Fund for Higher Education
FOE	Ordinary Fund for Public Research Organisations
FIRB	Future in Research (Fondo per gli investimenti nella ricerca di base)
FIRST	Basic Research Investment Fund
FP7	7th Framework Programme
FTE	Full-time equivalent
GARR	Italian Research & Education Network (Gestione Ampliamento Rete Ricerca Consortium)
GBAORD	Government Budget Appropriations or Outlays on R&D
GDP	Gross Domestic Product
GERD	Gross Domestic Expenditure on R&D
HE	Higher Education
HEI	Higher Education Institutions
HERD	Higher Education Expenditure on R&D
HES	Higher Education Sector
HIT2020	Horizon Italia 2020 (HIT2020)
HRST	Human Resources In Science And Technology
ICT	Information and Communication Technologies
IPR	Intellectual Property Right
ISCED	International Standard Classification of Education
IUC	Innovation Union Competitiveness
IUS	Innovation Union Scoreboard

IDA	Italian Digital Agenda (Agenda Digitale Italiana)
JRC-IPTS	Joint Research Centre - Institute for Prospective Technological Studies
KT	Knowledge Transfer
MAE	Ministry of Foreign Affairs (Ministero degli Esteri)
MISE	Ministry of Economic Development (Ministero dello Sviluppo Economico)
MIUR	Ministry of Education, University and Research (Ministero dell'Istruzione, Università e Ricerca)
NRP	National Reform Programme
OA	Open Access
OB1	Objective Area of The Structural Funds
OECD	Organisation for Economic Co-Operation and Development
PCM	Presidenza del Consiglio dei Ministri
PNR	National Research Program (Programma nazionale della ricerca)
PONREC	National Operational Program 'Research and Competitiveness'
PORs	Regional Operational Programs
PRIN	National Interest Research Program (Progetti di ricerca di interesse nazionale)
PROs	Public Research Organisations
R&D	Research and Development
R&I	Research and Innovation
RI	Research Infrastructures
RTDI	Research Technological Development and Innovation
S&T	Science And Technology
SCI	Science Citation Index
SF	Structural Funds
SME	Small And Medium Sized Enterprise
STI	Science, Technology and Industry
VQR	Five-Year Research Evaluation Exercise (Valutazione della qualità della ricerca)

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